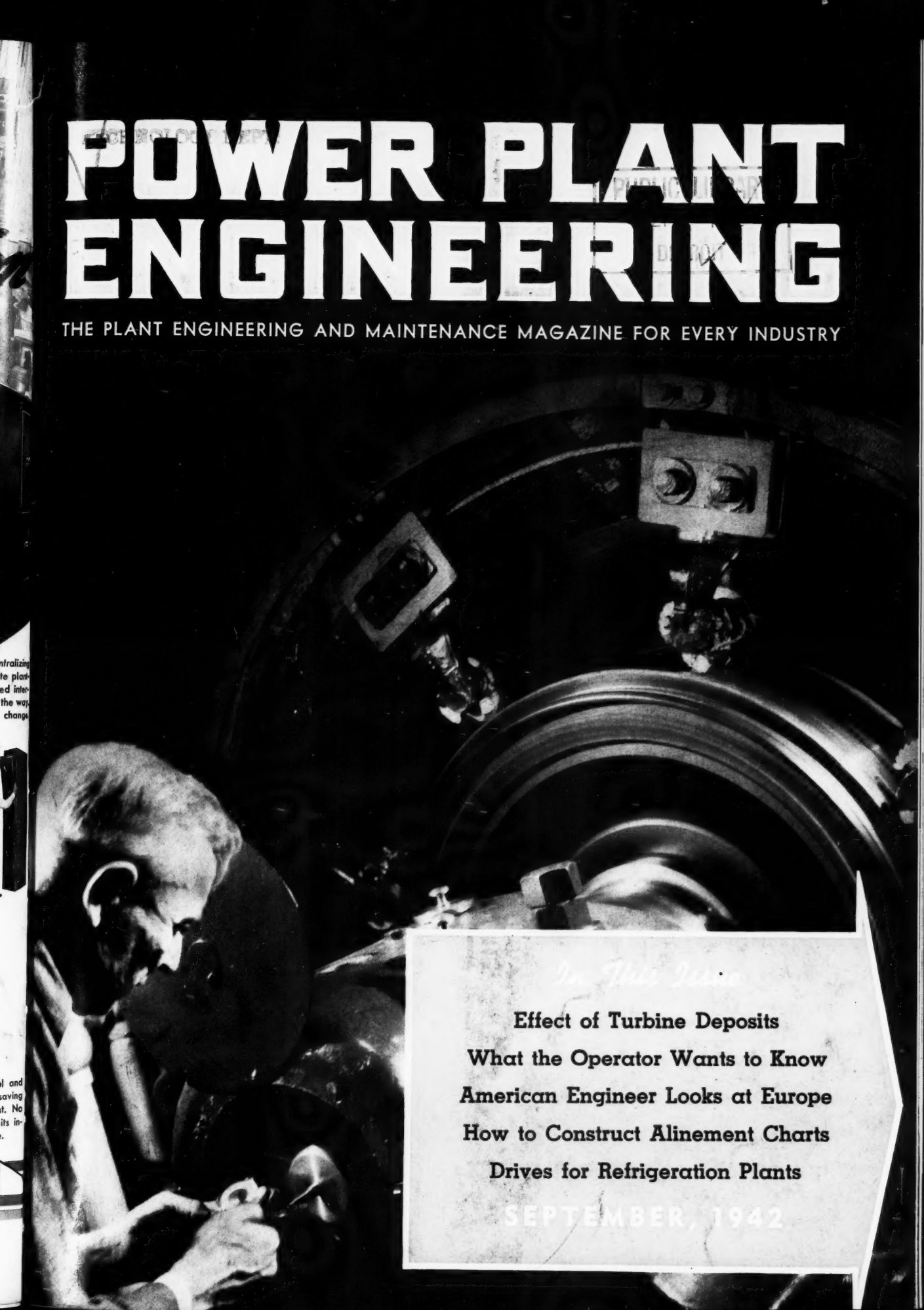
POWER PLANT ENGINEERING

THE PLANT ENGINEERING AND MAINTENANCE MAGAZINE FOR EVERY INDUSTRY



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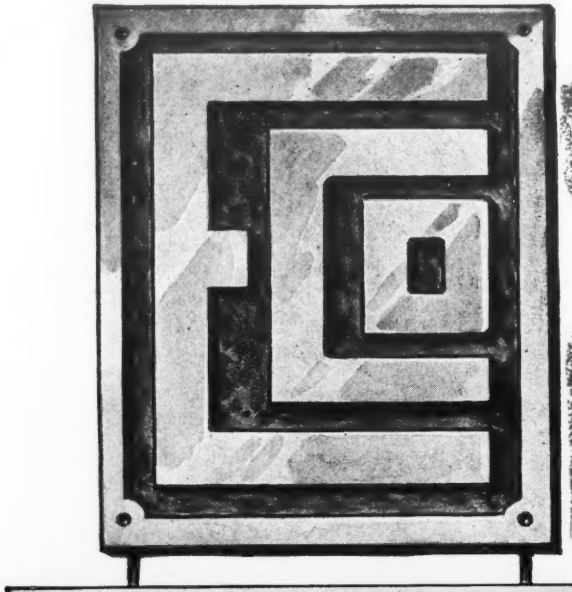
American Engineer Looks at Europe

How to Construct Alinement Charts

Drives for Refrigeration Plants

SEPTEMBER, 1942



TURBINE-GENERATORS

MECHANICAL DRIVE TURBINES

MOTORS

GENERATORS

MOTOR-GENERATORS

ELECTRIC COUPLINGS

CONDENSERS

DEAERATORS

Service bars . . . OF A VITAL WAR INDUSTRY

Look down this listing of Elliott products. Look *through* it, beyond it, to guns, tanks, planes, gun-powder, shells, steel, ships, all needed to insure the preservation of America. For that is what this listing represents.

Each of these bars stands for a successful campaign of engineering development whose fruits are now being turned against the Axis.

We believe that this war will be won by American Industry, developing a productive capacity totally unforeseen, particularly by the Axis powers. Signs of this development are its maximum at the earliest possible date, and that we can

CONDENSERS

DEAERATORS

CENTRIFUGAL BLOWERS

TURBOCHARGERS

DESUPERHEATERS

STRAINERS

SEPARATORS

GREASE EXTRACTORS

NON-RETURN VALVES

TUBE CLEANERS

ularly by the Axis powers. Signs of this development are its maximum at the earliest possible date, and that we can help by providing to the limit of our ability, the power equipment needed to turn the wheels of victorious production, as well as certain other equipment which utilizes that power.

Complete data on construction and application of the Elliott equipment here listed, is available at your special request.

Q-1086

ELLIOTT COMPANY

JEANNETTE, PA. • RIDGWAY, PA.

SPRINGFIELD, OHIO

DISTRICT OFFICES IN PRINCIPAL CITIES

B&W INTEGRAL-FURNACE BOILER

CLASSES 9, 12, AND 15

ADAPTABILITY INDICATED BY SALES RECORDS

The adaptability of the B&W Integral-Furnace Boiler in the smaller sizes — classes 9, 12, and 15 — is indicated by the table below, which shows the application of more than a hundred boilers on the basis of size and pressure. It is noteworthy that 72 per cent of these boilers are for stoker firing and the remainder are for oil firing.

APPLICATION OF BOILERS			
By Boiler Horsepower		By Steam Pressure	
Boiler Horsepower Range	Per Cent of Steam Capacity	Steam Pressure Range, Psi	Per Cent of Steam Capacity
100–400	25.7	150–200	73.3
400–600	66.8	200–250	22.7
600–700	7.5	250 Up	4.0

G-230

B&W Integral-Furnace Boilers bring to the smaller steam plants major advantages of special importance under present conditions: Smokeless combustion, simplified operation, reduced costs of fuel and maintenance, and economical construction. Details of this unit, including additional data on sizes available and space requirements, are given in Bulletin G-34-A —sent on request.

The Navy "E" Award to the Barberton Works for production achievement is "an honor not lightly bestowed and one to be cherished."

THE BABCOCK & WILCOX CO . . . . 85 LIBERTY STREET. . . . NEW YORK, N. Y.

BABCOCK & WILCOX

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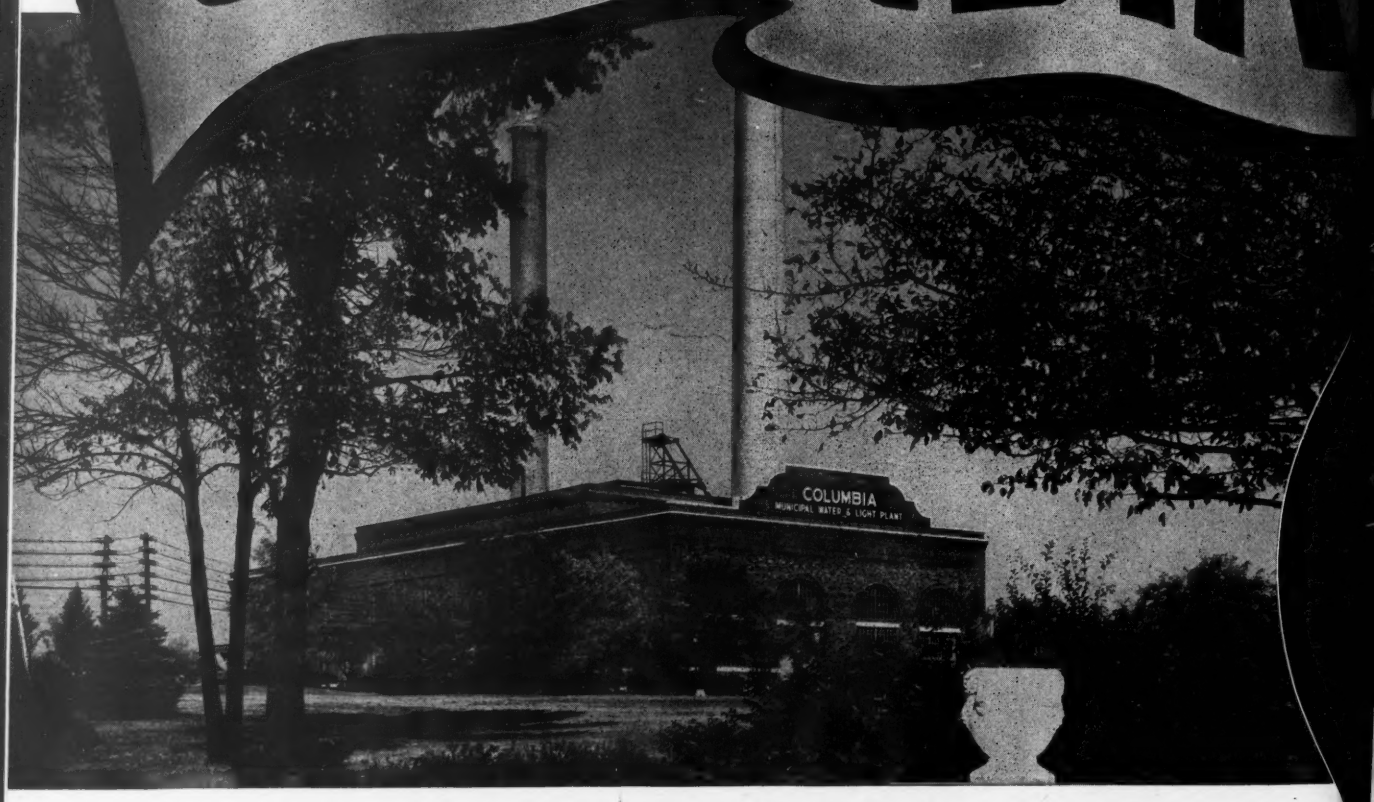
pride of COLUMBIA



Columbia, Missouri, Water & Light Plant (above).

Columbia, Missouri, has plenty to be proud of—

There's the University of Missouri (Memorial Tower, at left) . . . Stephens College . . . and Christian College.

Then there's the beautiful countryside that first attracted the Kentuckians who settled Columbia, back in 1815 . . . Good land for dairying, truck farming.

Coal mines and stone quarries are nearby. And the great Missouri River is only 10 miles south.

Columbia has railroads, industries. The city is proud (has a right to be) of the way her citizens and resident students have swung into action to help speed Victory.

Yes, this up-and-coming Missouri city has a lot to be proud of. And you'll find that Columbia's citizens take especial pride in the Water and Light facilities, so important to good health, comfort, civic and industrial progress.

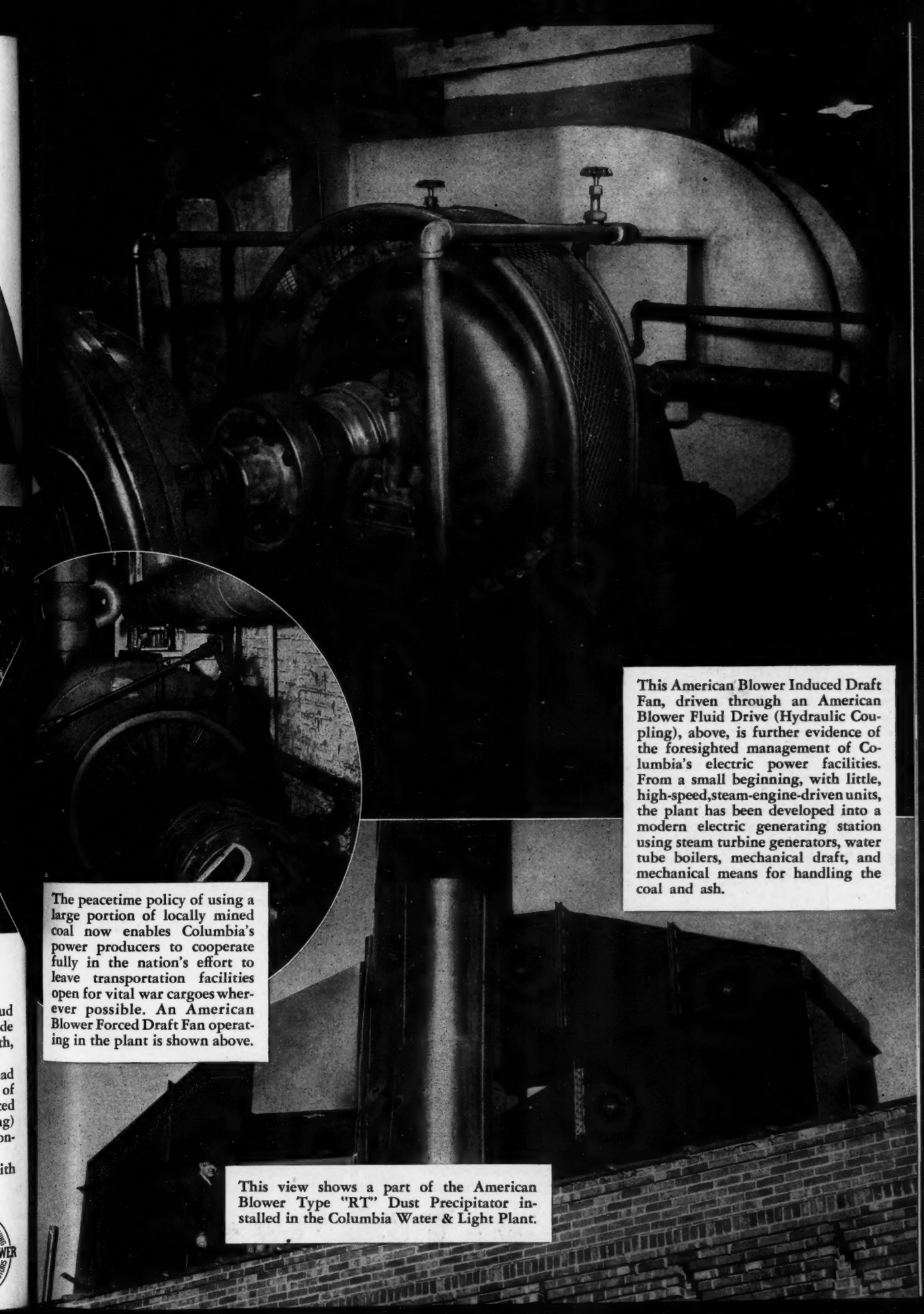
We of American Blower are proud, too, that we have had a part in equipping the modern electric generating station of the Columbia Water & Light Plant. American Blower Forced and Induced Draft Fans, Fluid Drive (Hydraulic Coupling) and Dust Precipitator equipment are dependably functioning here.

We would also welcome an opportunity to cooperate with you.

AMERICAN BLOWER

AMERICAN BLOWER CORPORATION, DETROIT, MICHIGAN • In Canada: CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of AMERICAN Radiator and Standard Sanitary Corporation

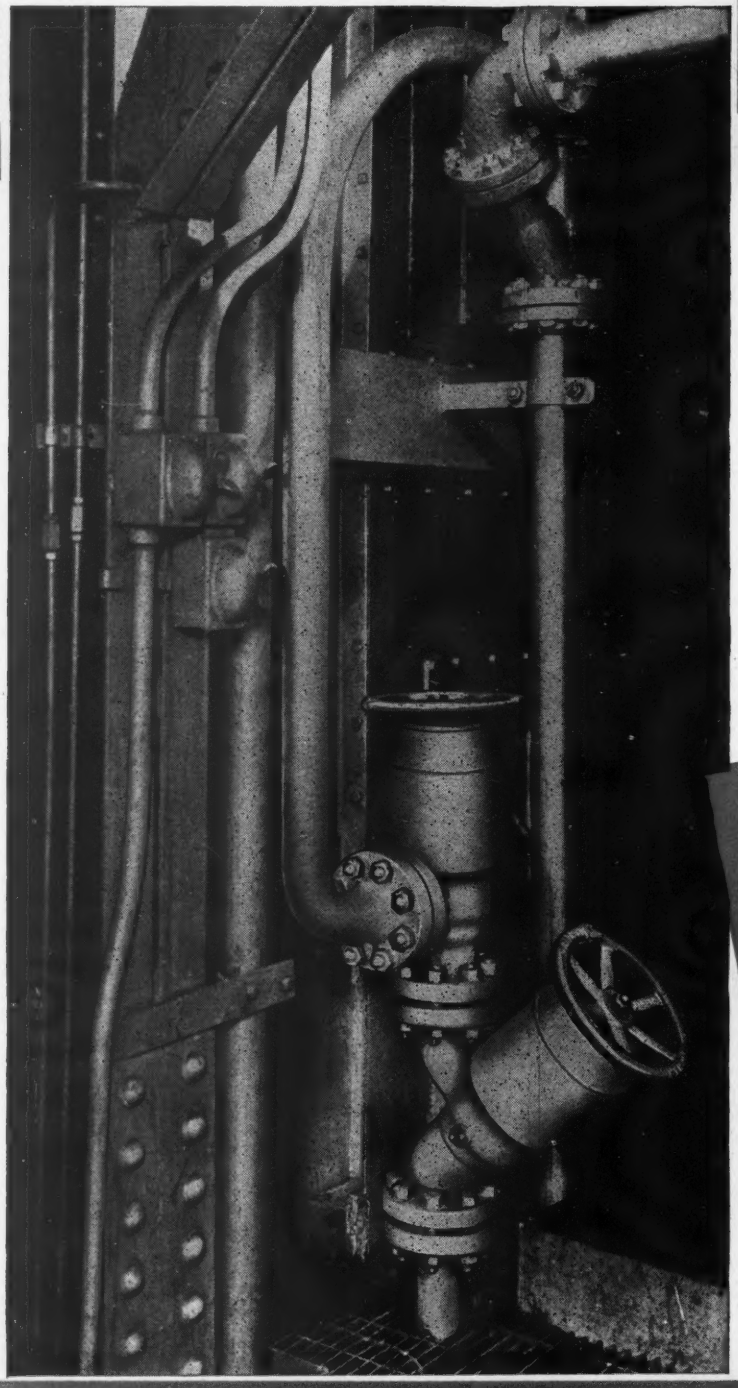


This American Blower Induced Draft Fan, driven through an American Blower Fluid Drive (Hydraulic Coupling), above, is further evidence of the foresighted management of Columbia's electric power facilities. From a small beginning, with little, high-speed, steam-engine-driven units, the plant has been developed into a modern electric generating station using steam turbine generators, water tube boilers, mechanical draft, and mechanical means for handling the coal and ash.

The peacetime policy of using a large portion of locally mined coal now enables Columbia's power producers to cooperate fully in the nation's effort to leave transportation facilities open for vital war cargoes wherever possible. An American Blower Forced Draft Fan operating in the plant is shown above.

This view shows a part of the American Blower Type "RT" Dust Precipitator installed in the Columbia Water & Light Plant.

240 YARWAY



At left: Typical view of the Yarway Seatless Tandem Valves in use on the boilers at Cahokia Station. Note that these valves are equipped with dust guards—good protection against stem wear when dust is encountered.

PROPER MAINTENANCE WILL LENGTHEN THE LIFE OF VITAL VALVES. Make sure these simple precautions are a part of your plant routine. Lubricate your Yarway Valves often, using the convenient Alemite fittings provided. Keep yoke nuts tight. Close valves down hard. Care will prevent wear—further increase normal long life. Send for detailed Instruction Card.

YARWAY

SEATLESS VALVES at Cahokia Station

AT the Union Electric Company's Cahokia Station, near St. Louis, 240 Yarway Seatless Blow-Off Valves used in tandem are employed on main boiler blow-down lines and water-wall drains of the 24 Boilers operating at 350 lbs pressure. Some of these Yarway Valves have been in service as long as 14 years and are still giving a good account of themselves.

Good reason why, when this same outstanding utility company planned the new Venice, Illinois, Station, Yarway Seatless Blow-Off Valves were used on these 885-lb pressure units.

Years of service in low, medium and high pressure plants of leading utilities and industrials have proved the sound design and metallurgy of Yarway Valves for blowing-down or draining and for sealing.

What are your drain or blow-down valve requirements? Write for Catalog B-421 for pressures up to 400 lbs; B-431 for pressures up to 2500 lbs.

YARNALL-WARING COMPANY
114 Mermaid Ave., Philadelphia, Pa.

Yarway Type C Seatless Tandem Blow-Off Valve (angle valve Fig. 3910, straightway valve Fig. 3912) for pressures up to 600 lbs.

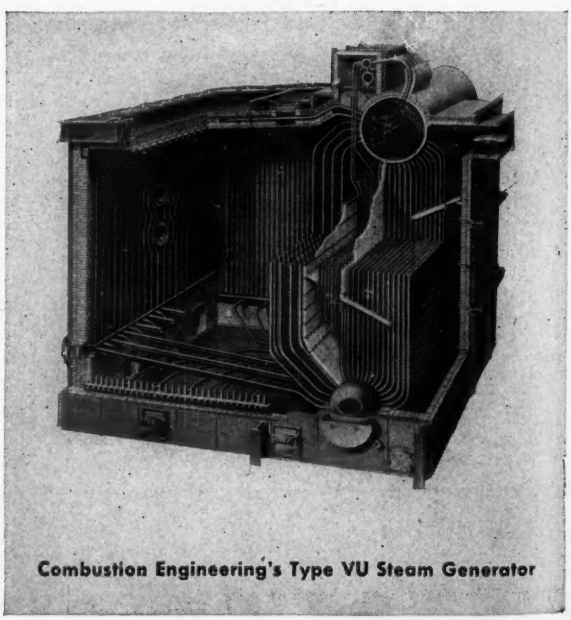
BLOW-OFF VALVES

why Jimmie Fowler of C-E's drafting dept. re-named the VU steam generator

"Jimmie," a squad leader in the VU division of C-E's Drafting Department, is in a good spot to know how much this modern steam generating unit is doing for the war industries.

He knows that over 100 of these units have been purchased for T.N.T. and smokeless powder plants, for shipyards, navy yards, naval bases, air fields and for The Defense Plant Corporation. He knows that these units can make a vast quantity of steam—over 10,000,000 lb per hr—to produce power for Victory.

Inspired by this picture, it was a natural step in Jimmie's mind to change the familiar designation "VU" to a name that really tells the story, "Victory Unit." And to put his idea to work, he made the sign reproduced opposite and hung it on the wall as a constant reminder to the men in his squad that their jobs are important to Uncle Sam.

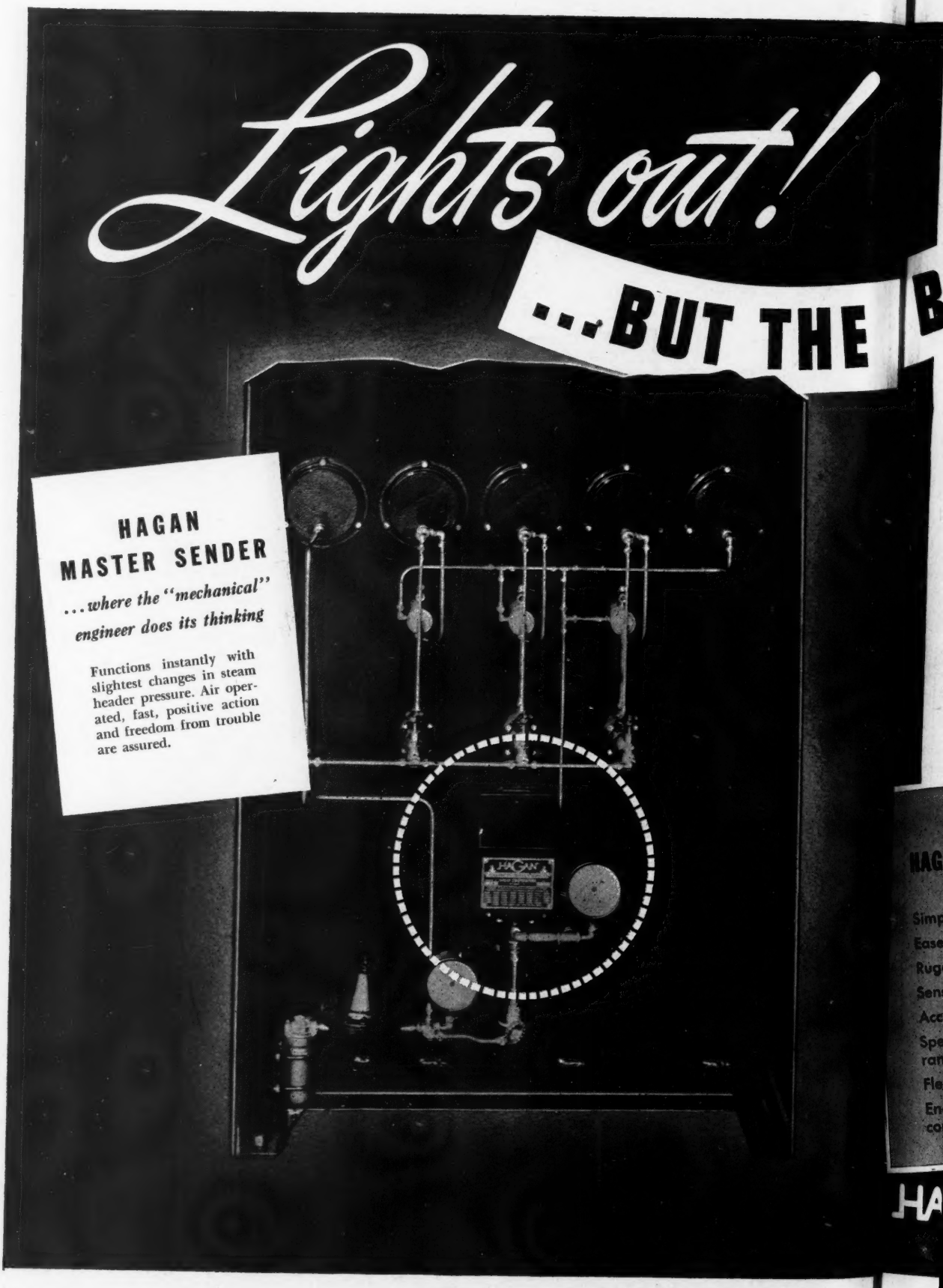


Combustion Engineering's Type VU Steam Generator

COMBUSTION ENGINEERING

200 MADISON AVENUE, NEW YORK, N. Y

A-674


Lights out!
...BUT THE
HAGAN
MASTER SENDER
...where the "mechanical" engineer does its thinking
Functions instantly with slightest changes in steam header pressure. Air operated, fast, positive action and freedom from trouble are assured.

BOILER PLANT CARRIES ON!

Combustion control so automatic that if you had to duck for shelter during a blackout you wouldn't have to give a thought to your steam situation

THAT kind of automatic combustion control is worth having. Certain Hagan-equipped plants in the war zone find it so now during air raids. It suggests a very interesting question.

Could you desert *your* plant hurriedly and feel completely confident that all would go well with your present system? You could if it had Hagan protection.

Hagan Automatic Combustion Control functions reliably, efficiently and *independently* under any load or operating conditions likely to arise.

And it does so instantaneously—at a speed no human hands could maintain.

If you have never enjoyed such freedom, that may look like a pretty big promise. But in thousands of Hagan-equipped plants nothing less is expected—or delivered.

Think what this would mean to you in meeting the trying conditions under which you work today.

And think of what you could also do for your steam output . . .

Hagan Control assures MAXIMUM steam output from any given fuel by introducing fuel and air to the furnace in correct proportions . . . MAXIMUM utilization value of the steam produced . . . MAXIMUM steam output from boilers of varying capacities through the proper distribution of *load* . . . MAXIMUM use of steam for productive work by reducing soot blowing operations.

Hagan Control is engineered, today, by the men who pioneered in the combustion control field. Hagan Control owes its leadership to proved mechanical superiority.

Why not let a Hagan combustion specialist explain how it works — show what it could do for your war effort? Write or wire, today.

HAGAN CORPORATION
HAGAN BUILDING
PITTSBURGH, PA.

SPECIFIC ADVANTAGES OF HAGAN AUTOMATIC COMBUSTION CONTROL

Simplicity of operation.
Ease of installation.
Ruggedness of equipment.
Sensitivity to small load changes.
Accuracy of adjustments for small variations.
Speed of movement, with stability, throughout operating range.
Flexibility in meeting individual plant conditions.
Engineered by the pioneers and leaders in automatic combustion control.

HAGAN *Automatic* COMBUSTION CONTROL

The pioneer . . . and still the leader

Low Maintenance and Long Life!

Use
ARMSTRONG STEAM TRAPS

6/100 of 1¢ per trap-per year

WITH ordinary steam traps and particularly older types of traps, maintenance expense depends a lot on how clean the steam is . . . how much oxygen or CO_2 is dissolved in the condensate . . . how high a pressure is carried in the system, etc. The fact that modern Armstrong traps are immune to the ill effects of adverse conditions is due to such features as use of quality construction for entire operating mechanism . . . exclusive free-floating valve with no fixed pivots . . . tight closing, wide opening valve operating cycle . . . and natural self-scrubbing action!

How well Armstrong has succeeded in reducing trap maintenance expense is suggested by a report from the Blind Floral Co., Pittsburgh, Pa. This company now has 165 Armstrong traps, some of which are shown above. The average age of the trap is 5 years. The total repair cost to date figures just six hundredths of a cent per trap per year!

ARMSTRONG MACHINE WORKS
810 Maple Street, Three Rivers, Mich.

THE QUALITY stands out!

SIMPLE, DEPENDABLE INTERIOR MECHANISM. First developed to meet unusually severe service conditions, this construction is now standard at no extra cost.

HEAT TREATED VALVE AND SEAT. The same quality and special alloy composition as used in Armstrong traps for 1500 lbs. pressure service.

INDIVIDUALLY TESTED. Even traps for lowest pressures have close grain, semi-steel bodies and are tested with a minimum hydraulic pressure of 500 lbs. per sq. in. for tightness. Valves and seats are lapped together for maximum tightness.

ADVANCED DESIGN. Free-Floating valve, no fixed pivots to wear, no narrow clearances. Positive valve action—wide opening, tight closing. No steam leakage with light loads. Non-airbinding . . . self-scrubbing . . . big capacity!

DEARBORN ENGINEER HAS

"54 BROTHERS"

DOUBLING FOR HIM

Every plant in the U. S. A. is within daily calling distance of one of them . . . . . .

It is this human side of Dearborn service, and not merely the chemicals and feeding systems, which means so much when you get in a jam. Many things can happen to boilers carrying more than normal loads. Dearborn Engineer can put his finger on the cause of water troubles; in fact he comes to you with a head full of answers to old as well as new water problems.

He knows local water characteristics, too, because he has worked and lived in his district a long time. Even the latest war production contaminating factors affecting local waters are familiar to him.

The big Dearborn Laboratory provides him with the facilities to develop corrective measures that eliminate time-consuming shutdowns and costly repairs due to scale, foaming, and corrosion.

He's a good man to know . . . to help get you out of a jam, or for consultation. Drop us a line . . . we'll see that he calls.

DEARBORN CHEMICAL COMPANY
Dept. F, 310 S. Michigan Avenue
Chicago, Illinois

Dearborn Engineer does this for you . . .

(1) Studies your water and plant operating conditions.
(2) Sends samples of your water to main laboratory for analysis.
(3) Recommends proper chemical treatment and chemical control methods.
(4) Supervises installation of feeding equipment.
(5) Instructs your men on water test methods for treatment dosage adjustment and blow-down control.
(6) Calls regularly to insure maintenance of recommended conditions.

Dearborn

WATER TREATMENT AND ENGINEERING SERVICE

Iron Fireman P-S Stoker Cuts Fuel C

Pneumatic Spreader

THE LIMOGES CHINA COMPANY
ESTABLISHED 1900
Manufacturing Potters
SEBRING, OHIO

May 13, 1942

A Typical Example of Iron Fireman P.S. Performance

Iron Fireman Corporation
3170 West 106 Street
Cleveland, Ohio

Gentlemen:

We think that possibly you will be interested in the results we have obtained with our Iron Fireman Pneumatic Spreader stoker, installed in the fall of 1940.

We have two 150 horsepower H.R.T. boilers, operating at 85 lbs. pressure. Before the installation of the Iron Fireman stoker it was necessary for us to fire both boilers by hand, in order to take care of our steam demands. The Iron Fireman was installed in one of these boilers and we were able to discontinue the use of the other, excepting in extremely cold weather, when it is used occasionally.

In addition to making cash savings on our fuel bills amounting to $2,448.00 per year, we have been able to maintain uniform steam pressure, under all operating conditions, and have materially cut the cost of boiler maintenance.

Another decided advantage is the fact that now we have a warm plant held at a uniform temperature, something we didn't have before installing the Iron Fireman.

We are more than satisfied with the performance of your equipment, which is reliable, well engineered and built, and is most satisfactory. We will be happy to show this equipment to anyone interested.

Very truly yours,

THE LIMOGES CHINA COMPANY

Harrison Keller

Vice President

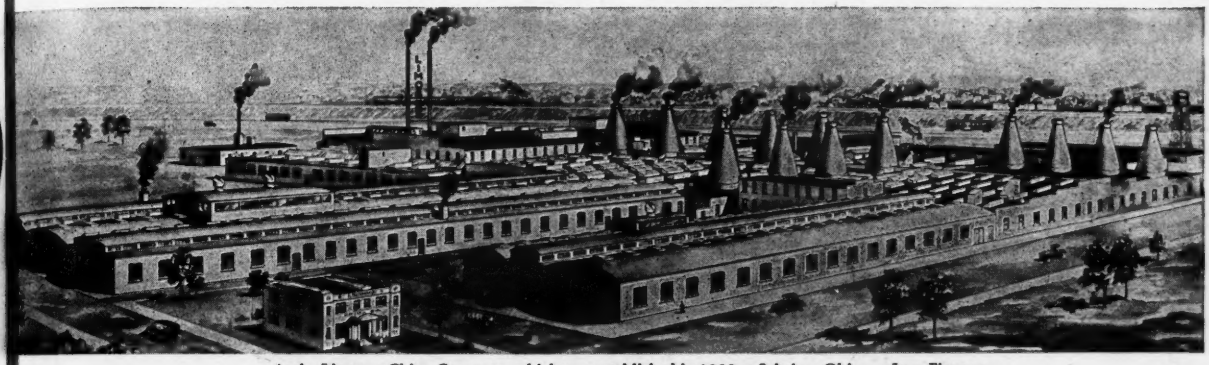
IRON FIREMAN

THE IRON FIREMAN

Automatic Coal Stokers

Costs $2448 Annually

Maintains Uniform Steam Pressure . . . Reduces Boiler Maintenance . . . Eliminates Use of One Boiler

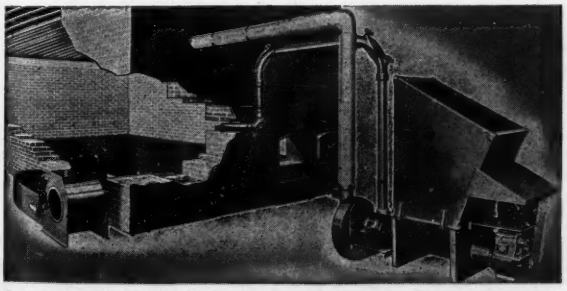


At the Limoges China Company, which was established in 1900 at Sebring, Ohio, an Iron Fireman P. S. stoker operates 24 hours a day supplying steam for power, processing, and heating.

Pneumatic Spreader Gives More FIRE POWER

In large plants from coast to coast Iron Fireman P. S. stokers give more *fire power*. One P. S.-fired 150 h.p. H.R.T. boiler at Limoges meets the steam demands formerly requiring two hand-fired boilers. Besides Iron Fireman P. S. firing reduced the fuel costs from $12,672 to $10,224 a year. P. S. firing maintains uniform steam pressure under all operating conditions.

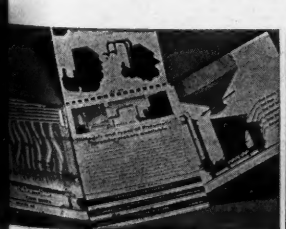
Free Engineering Survey. Iron Fireman engineers are ready to make a complete survey of your boiler plant to see how an Iron Fireman stoker can give you more fire power. There is no obligation, and Iron Fireman engineers will be glad to collaborate with your plant or consulting engineer.



Quickly installed. This diagrammatic view shows the operation of the P. S. stoker. Steam-size coal is conveyed from the hopper or bunker to a transfer housing. Here the coal is picked up by a stream of air and carried to the furnace and grates. The fines burn in suspension, utilizing the conveying air for combustion.

Iron Fireman FIRE POWER Speeds War Production 8 Ways

1. Increases steam capacity from present boilers.
2. Greater capacity and firing efficiency for new boilers installed in new or enlarged plants.
3. Decreases man-hours of labor in boiler rooms, to release men for 7-day war production.
4. Freedom from dependence on fuel oil and gas, of which there are now serious shortages.
5. Makes more steam from a smaller tonnage of coal, thus conserving this vital fuel.
6. Burns local coals and lower grade coals which prevents transportation "bottlenecks."
7. Automatically controlled firing gives uniform steam pressure for power, heating and process steam, regardless of fluctuating loads.
8. Provides a *dependable* source of steam for all-out war effort.



FREE BOOK on Pneumatic Spreader Firing

Contains full descriptions, capacities, operating data, etc., with layouts and photos of 10 actual installations. Sent free, on request. Write to Iron Fireman Mfg. Co., 3319 W. 106th Street, Cleveland, Ohio.

Power supplied by the oscillator vibrates the buckets through a rod connected to a loudspeaker-like device.

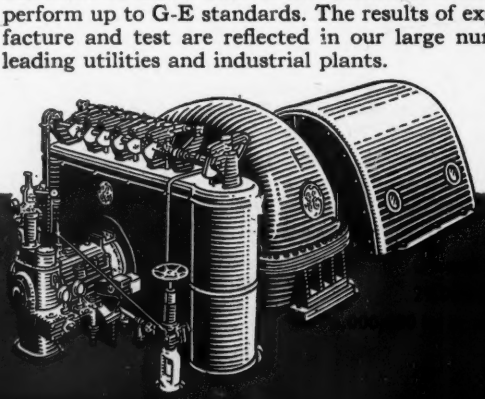
Engineers move the crystal detector along the bucket tips and relay the bucket's vibrations to the oscillograph. Points of peak vibration are noted.

On the screen of the oscillograph the vibrations are magnified 100,000 times to show the frequency of the turbine bucket.

WITH the high temperatures in use today and wheel-tip speeds exceeding 800 miles per hour in many units, it is essential that every feature of bucket design and construction be thoroughly tested. Our turbine designers are constantly studying vibrations in these buckets, but until recently it has been difficult to make comprehensive tests on the shorter ones because of their very high natural vibration frequency—a condition almost impossible to reproduce outside the turbine with sufficient strength for study. The problem of artificially producing and recording such vibrations resulted in developing specialized test equipment—a 1000-watt audio oscillator which produces power at frequencies of 30 to 20,000 cycles per second.

The oscillator (above) produces and delivers power at constant frequency to a loudspeaker-like device which vibrates the turbine buckets. As the buckets vibrate, the engineer moves a crystal vibration detector along their tips to relay their resultant frequency to an oscillograph. By watching the oscillograph screen—where the bucket vibration is magnified 100,000 times—he can study the vibration pattern and then so design a wheel that resonance will not occur at normal speed.

General Electric turbine engineers make use of many other tests. This attention to detail adds to the assurance that the completed turbine will perform up to G-E standards. The results of experienced and skilled manufacture and test are reflected in our large number of repeat orders from leading utilities and industrial plants.



The Navy "E", for Excellence, has been awarded to 92,780 General Electric employees in five plants manufacturing naval equipment.

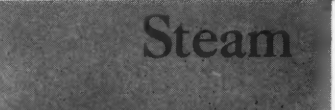
10 years of continuous service
Less than $450 for renewal parts
200,000,000 kilowatt-hours generated

THAT'S the performance record achieved by one General Electric turbine-generator—in a North Carolina power plant. Every operating hour for ten years, this 5000-kilowatt unit generated dependable, low-cost power without a single mechanical failure. Minor renewal parts—mostly packing materials—cost less than $45 a year. Today, this turbine is helping to carry peak loads as a stand-by unit, while a later 7500-kilowatt, 700-degree, 250- or 450-pound unit, which has been in operation two years, has consistently exceeded the performance guarantee. Coal consumption has been reduced from an average of 1.75 pounds per kilowatt-hour to 1.25 pounds, with a one-day low of 1.14 pounds.

Twenty-six years ago a G-E turbine-generator—a 500-kilowatt unit—was installed in this plant. When additional units were required—five, ten, fourteen, and twenty-four years later—"General Electric" was specified each time. These repeat orders were earned by good engineering.

Whatever the steam conditions, the buyer of a General Electric turbine is assured of superior all-round performance, for in it are combined the results of more than 40 years of constant research and development. The turbine specialist in our nearest office can give you valuable assistance in connection with the use of turbines, not only for power generation but also for mechanical drive. He will be glad to work with you or your consulting engineers in the selection of the right equipment. General Electric, Schenectady, N. Y.

First Aid Chart

	WAR CONDITIONS	POWER PROBLEMS
Manpower	Skilled operators being called for military service. Fewer experienced operators available for replacement. Inexperienced men to be trained.	Power plants must be operated at maximum capacity and efficiency with fewer skilled operators who, at the same time, must aid in the training of new and inexperienced men.
Fuel	Transportation difficulties threaten curtailment of fuel shipments causing temporary fuel shortages.	Emergency fuel must be obtained and stored. Available fuel must be burned at maximum efficiency to stretch present supply and to minimize haulage. Must be prepared to burn a substitute fuel if necessary.
Steam 	Big increase in steam demand. Lack of generating capacity. New steam generating equipment hard to get even with good priorities.	Every possible pound of steam must be squeezed from present generating units to meet new load demand. Process steam waste must be checked and held to a minimum.
Maintenance	All equipment operating at overload. No stand-by equipment. Replacement parts difficult to obtain. Inexperienced operators.	Maintenance and repairs must be taken care of promptly, in spite of a shortage of experienced maintenance men or difficulties in getting materials, in order to avoid major shut-downs.

REPUBLIC
INSTRUMENTS
AND CONTROLS

FOR SOLVING WARTIME POWER PLANT PROBLEMS

THROUGH the use of instruments and controls you may be able to increase your steam supply just enough to get it over the peak. Republic engineers will be glad to consult with you. Write to us today.

INSTRUMENTS	BOILER CONTROLS	PROCESS CONTROLS
IMPROVE SUPERVISION Instruments provide operators with continuous indications of operating conditions. Permit centralized supervision of all operating factors. Provide continuous record of performance.	**CONSERVE MANPOWER** Automatic boiler controls, by performing the routine repetitive adjustments, free the operators for more important supervisory duties.	**STRETCH SKILL** Automatically perform routine repetitive adjustments to maintain desired conditions thereby enabling the operator to supervise the operation of a larger number of units.
CHECK LOSSES CO_2 meters, draft gages and flue gas temperature recorders provide a continuous check on combustion efficiency and preventable heat losses. Steam meters serve as a guide for the proper load distribution among boilers.	**SAVE FUEL** Automatically maintain highest combustion efficiency by controlling fuel and air input, in a fixed predetermined ratio, over the normal load range. Provide for changes in fuel characteristics and other operating factors.	**REDUCE WASTE** For every pound of steam wasted and for each extra gallon of water pumped, etc., a corresponding amount of fuel had to be consumed in the boiler room. Automatic controls reduce power waste and thereby save fuel.
CHECK STEAM WASTE Meters installed on main distribution lines will immediately center attention on the department or unit using excessive amounts of steam. They provide the information needed to coordinate steam consumption with steam production.	**TEST EFFICIENCY** Produce maximum steam output at test efficiency by maintaining constant steam pressure, maximum combustion efficiency, constant and correct furnace draft and desired load division among boilers.	**MORE STEAM** By reducing the power consumption of pumps, compressors, dryers or other steam consuming units, through the use of automatic controls, you increase the effective capacity of your power plant.
LOCATE TROUBLE SPOTS Instruments, by providing a check on the performance of various units, are invaluable in spotting potential trouble spots before they develop to a point where they require extensive repairs and interfere with production.	**REDUCE OUTAGES** Correct boiler operation reduces outages. Boiler controls, by coordinating all operating factors, prevent the chain-of-events type of trouble that may lead to serious shut-downs.	**UNIFORM PERFORMANCE** Maintain correct process conditions under continuous operation at peak capacity. When both operators and equipment are working at capacity close control is vital to prevent serious maintenance outages.

Republic Flow Meters Co.

2224 Diversey Parkway • Chicago, Illinois

WHEN YOU WANT T
YOU WANT A-E-CO T

PROBLEM:

The selection of fuel firing equipment by a municipal electric light plant for a high pressure boiler supplying modern turbine generating equipment. Most important factor was reliability—together with equipment which would preclude any problem of flame stability and the need for auxiliary fuel at lower steaming rates.

SOLUTION:

A Taylor Hydraulic Ram-Driven Stoker was installed under a high pressure boiler of 100,000 lbs. per hour capacity. The furnace was equipped with A-E-CO inclined side water walls and rear waterwall.

RESULTS:

For the two-year period of 1940-1941, 593,070,000 lbs. of steam were generated, burning 54,326,000 lbs. of coal. The average evaporation for the period was 10.9 lbs. of steam per lb. of coal; average B.T.U. per lb. coal as fired 14,267. Operating conditions were: pressure 400 lbs. gauge; steam temperature 725°F.; temperature feed water to boiler 302°F. The combined efficiency of the unit was 84.4%, preheated air temperature to stoker 300 to 325°F.

CONCLUSIONS:

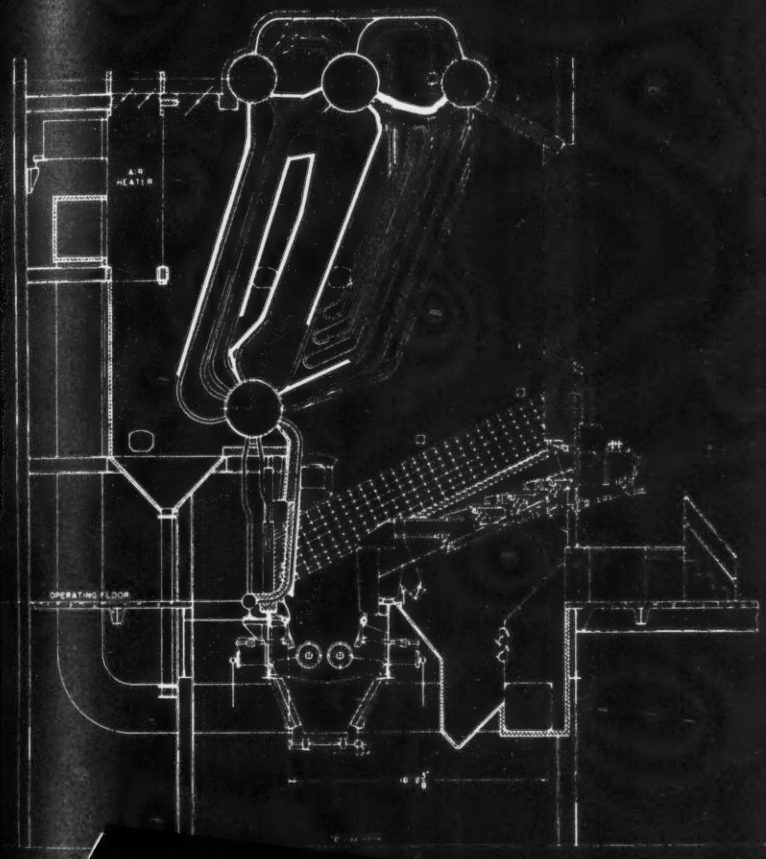
When considering reliability for a light plant load it is necessary to take into account the wide steaming range and the problems of flame stability and use of auxiliary fuel at light ratings. Choice of a Taylor Stoker eliminates all these factors. Ignition is no problem at light steaming loads and auxiliary fuel is not required regardless of the minimum load met.

A CASE IN THE MUNICIPAL PLANT FIELD

AMERICAN ENGINEERING

PHILADELPHIA

T THESE RESULTS
O TAYLOR STOKERS



A-E-CO TAYLOR STOKERS ON THE FIRING LINE

*Aluminum Company of America, Edgewater, N. J.
*Aluminum Company of America, New Kensington, Pa.
American Tobacco Co., Inc., Durham, N. C.
Castanea Paper Company, Johnsonburg, Penna.
Chrysler Corporation, DeSoto Plant, Detroit, Mich.
*Collins and Aikman Corp., Roxboro, N. C.
City of Columbus, Ohio
*Consolidated Paper Company, Monroe, Michigan
*Cresson State Sanitarium, Cresson, Penna.
Defiance Milk Products Co., Defiance, Ohio
*DeLaval Steam Turbine Co., Trenton, N. J.
*Detroit Sulphite Pulp & Paper Co., Detroit, Michigan
City of Dover, Ohio
*Draper Corporation, Hopedale, Mass.
Erwin Cotton Mills Co., West Durham, N. C.
*Fisher Body Corporation, Detroit, Michigan
Fisher Body Corporation, Fleetwood Plant, Michigan
*Fisher Body Corporation, Grand Rapids, Michigan
*Fisher Body Corporation, Pontiac, Michigan
Fox Paper Company, Lockland, Ohio
Froedtert Grain and Malting Co., Milwaukee, Wisc.
*City of Galion, Ohio
Gardner-Richardson Company, Lockland, Ohio
*General Electric Company, Erie, Penna.
*General Electric Company, Fort Wayne, Ind.
*Greenwood Electric L. & W. Plant, Greenwood, Miss.
*Board Public Works, Hannibal, Mo.
Hill School, Pottstown, Penna.
*Hobart Mfg. Co., Troy, Ohio
*City of Holland, Michigan
*Hope Natural Gas Co., Cornwell Station, West Va.
Hudepohl Brewing Co., Cincinnati, Ohio
Industrial Cotton Mills, Rock Hill, S. C.
*City Water & Light Plant, Jonesboro, Ark.
Kohler Company, Kohler, Wisc.
Maryland State Penal Farm, Roxbury, Md.
Maybury Sanitarium, Northville, Michigan
Michigan Carton Company, Battle Creek, Michigan
*Michigan State College, East Lansing, Mich.
Municipal Light Plant, Marshfield, Wisc.
*Pacific Mills, Lyman, S. C.
*Packard Motor Car Co., Detroit, Michigan
*Municipal Electric Plant, Painesville, Ohio
*Park Drop Forge, Cleveland, Ohio
*Pennsylvania Electric Co., Seward, Penna.
*Pennsylvania R. R. Co., Philadelphia, Penna.
*Picatinny Arsenal, Dover, N. J.
*Pittsburgh Plate Glass Co., Barberton, Ohio
Borough of Quakertown, Quakertown, Penna.
Rdeigh Wyoming Mining Co., Glen Rogers, W. Va.
*Rhinelander Paper Company, Rhinelander, Wisc.
City of Richland Center, Wisconsin
*City of Richmond, Indiana
Sayles Biltmore Bleachery, Biltmore, N. C.
Scotten Dillon Company, Detroit, Michigan
Shelby Cotton Mills, Shelby, N. C.
Sloane-Blabon Corp., Philadelphia, Penna.
*Solvay Process Company, Detroit, Michigan
St. Elizabeth's Hospital, Washington, D. C.
City of St. Bernard, Ohio
Swarthmore College, Swarthmore, Penna.
*Timken Roller Bearing Co., Canton, Ohio
Timken Roller Bearing Co., Gambrinus, Ohio
Municipal Water & Light Plant, Tippecanoe City, O.
City of Toledo, Ohio
*Union Bleachery, Greenville, S. C.
Union Mills Paper Mfg. Co., New Hope, Penna.
*University of Wisconsin, Madison, Wisc.
*Vassar College, Poughkeepsie, New York
*Borough of Vineland, New Jersey
Warfield Natural Gas Company, Harold, Kennedy
White Sewing Machine Co., Cleveland, Ohio
Whiting Plover Paper Company, Stevens Point, Wisc.

(*) *Represents repeat orders.*

A-E-CO TAYLOR STOKER

A-E-CO TAYLOR STOKERS
WATER WALLS · ASH HOPPERS
ELE-SHAW FLUID POWER
MARINE DECK AUXILIARIES
LO-HED HOISTS

OMPANY

BEFORE YOU BUY ANY FUEL FIRING EQUIPMENT CONSIDER EACH OF THESE 12 FACTORS

1. **RELIABILITY**—the ability to operate with minimum outage and minimum standby equipment.
2. **CAPACITY**—the ability to provide adequate prime capacity ratings, with sufficient reserve capacity for emergencies.
3. **MAINTENANCE**—the ability to operate continuously with minimum repair costs.
4. **FLEXIBILITY**—the ability to follow the steam demand upward or downward . . . quickly and without sacrificing efficiency.
5. **EFFICIENCY**—the proved dollar efficiency (total cost of steam production) as shown by actual performance in similar installations.
6. **OPERATION**—the ability to operate continuously, the number and type of operations required, the ease of combustion adjustments, etc.
7. **ADAPTABILITY**—the ability to meet special and limiting conditions, present and future—structural limitations, utilization of present equipment, growth and change of power service demands.
8. **FUEL FLEXIBILITY**—the ability to burn efficiently and easily fuels from many sources having widely varying characteristics.
9. **REFUSE DISPOSAL**—the ability to economically eliminate ash or refuse and the opportunities of disposal at low cost, no cost, or profit.
10. **STACK DISCHARGE**—the practical elimination of "smoke nuisance" without special equipment.
11. **SPACE REQUIREMENTS**—the ability to conform to existing or future space limitations, to short and wide or long and narrow furnaces. Also the accessibility of component parts for maintenance and operation.
12. **OBSOLESCENCE**—the adaptability of the equipment toward possible future modernization with minimum of complication and outage.

Situated in an Illinois industrial area, this central station's Metermax Combustion Controllers are helping meet the power needs of scores of war-rushed, emergency-handling plants. Note the convenience to the operator of having the Controllers, as well as switches, etc., directly on the instrument panel—this arrangement is standard—not special—with Metermax.

War-Load Emergencies? Metermax Meets Them!

Ability to head off trouble, in present-day power-plant operations, is one of Metermax Control's principal assets. Several dozen features of the Control apply, in one or another of the emergency situations which may arise; here, for example, are four which are especially useful if the power plant's air or electric services are interrupted:

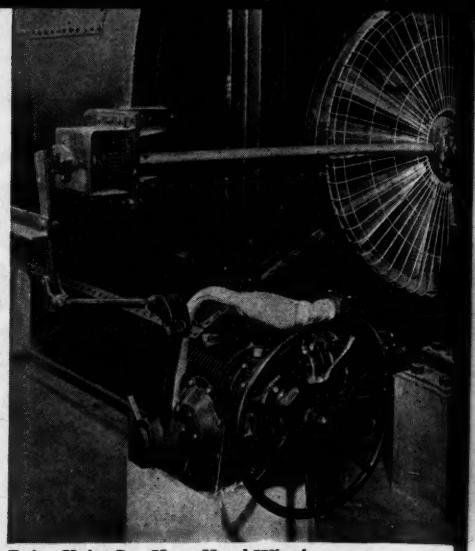
1. Should the air-supply fail, there's a 20-minute reserve (for 6 boilers) in a tank furnished as part of the Control. Metermax uses only about ½ cu. ft. of air per minute, and pressure is only 12 to 14 in. water.

2. If prolonged air-failure should exhaust the reserve supply, the dampers, etc., would automatically remain in existing positions, but could then be moved by push-button control, or by hand.

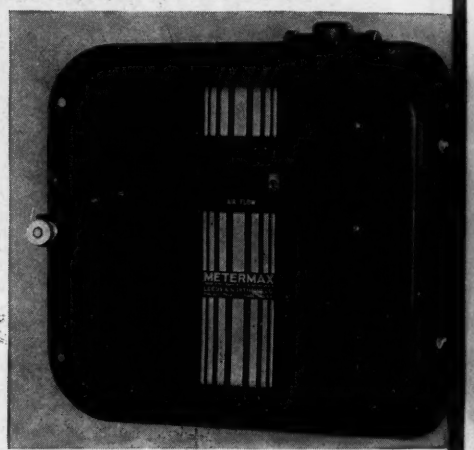
3. In case of failure of electric supply to the drive units, the dampers, etc., would remain in existing positions unless moved by hand. Dampers cannot back-drive a de-energized Metermax drive unit.

4. Operator can turn instantly from automatic to manual control, by simply throwing a switch. It is not necessary to balance pressures or lose time in any other way.

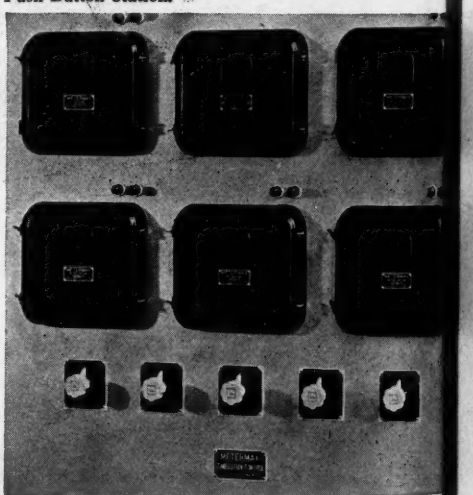
Metermax Combustion Control is described, with photographs and layout diagrams for various types of boilers, in our 32-page Catalog N-01-163, which will be sent on request. For more specific engineering information, just outline your problem.



Drive Units Can Have Hand Wheels



Controllers Can Be Provided With Integral Push Button Station.



The Switch Setting Determines Whether Control Is Automatic Or Manual. The Transfer Can Be Made Quickly Without Balancing Pressure.

Jrl Ad N-01-163(3)

LEEDS & NORTHRUP COMPANY, 4973 STENTON AVE., PHILA., PA.

LEEDS & NORTHRUP

MEASURING INSTRUMENTS . TELEMETERS AUTOMATIC CONTROLS HEAT-TREATING FURNACES

...excerpt from a letter marked "PERSONAL"

I've marked this letter "Personal," not as a trick to attract your attention, but because it must take the place of a personal call that I've tried to find time to make—without success.

We are busy at Foster. In a few all-too-short months, we have changed our entire organization from a private enterprise to a tireless war machine. We, too, have gone all out—not merely for defense, but for *victory*.

We realize that this change has effected our "normal" business relations with many of our customers. But these are not "normal" times . . . we *must* avoid too little, too late—war work *must* come first here just as it does in your plant.

We have not forgotten our old customers. We can still make valves for you—but if we seem slow in answering your inquiry; if our delivery dates seem unreasonable, be assured that it is not indifference, not a lack of appreciation of past favors.

It's simply that we're "in" on this business of winning the war —and when the war is won, we will be back "on schedule."

FOSTER ENGINEERING Company

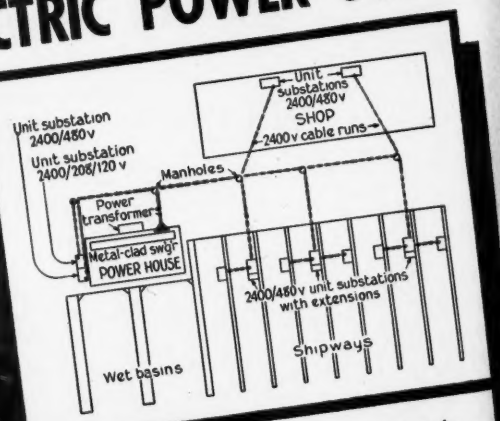
PRESSURE REGULATORS...RELIEF AND BACK PRESSURE VALVES...AUTOMATIC STOP AND CHECK VALVES...ALTITUDE VALVES...DAMPER REGULATORS...FAN ENGINE REGULATORS...PUMP GOVERNORS...TEMPERATURE REGULATORS...LIQUID LEVEL CONTROLLERS...FLOAT AND LEVER BALANCED VALVES...NON-RETURN AND TRIPLE DUTY VALVES...VACUUM REGULATORS OR BREAKERS...SIGHT FLOW BOXES...STRAINERS...SAFETY VALVES...SIRENS

109 MONROE STREET • NEWARK, N. J.

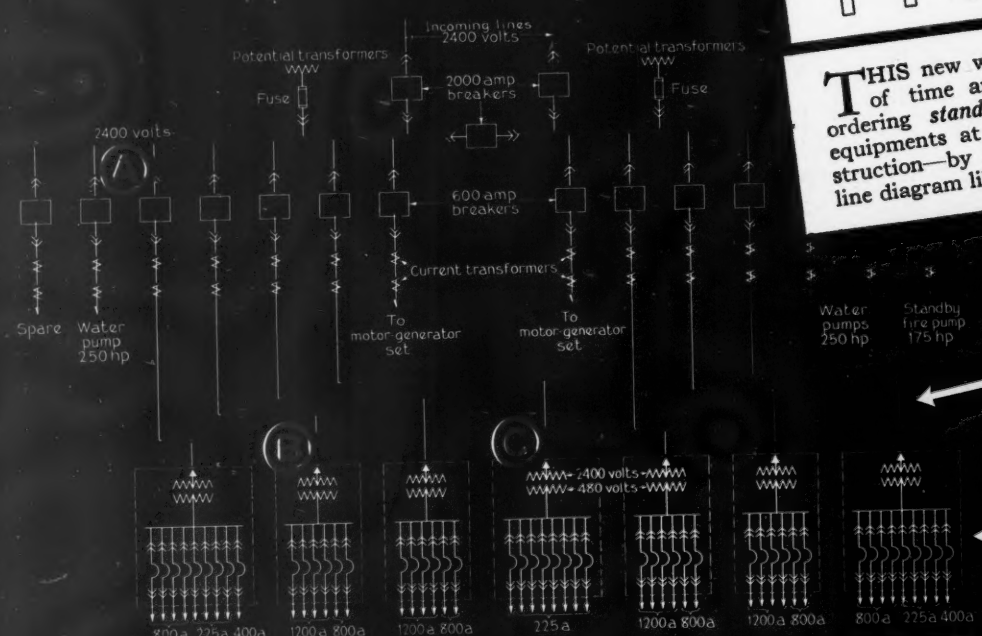
9-FE-2

1/4 THE TIME 1/7 THE COPPER

AND A BETTER ELECTRIC POWER SYSTEM



THIS new war plant saved months of time and tons of copper by ordering *standard* power distribution equipments at an early stage of construction—by means of a simple one-line diagram like that below.



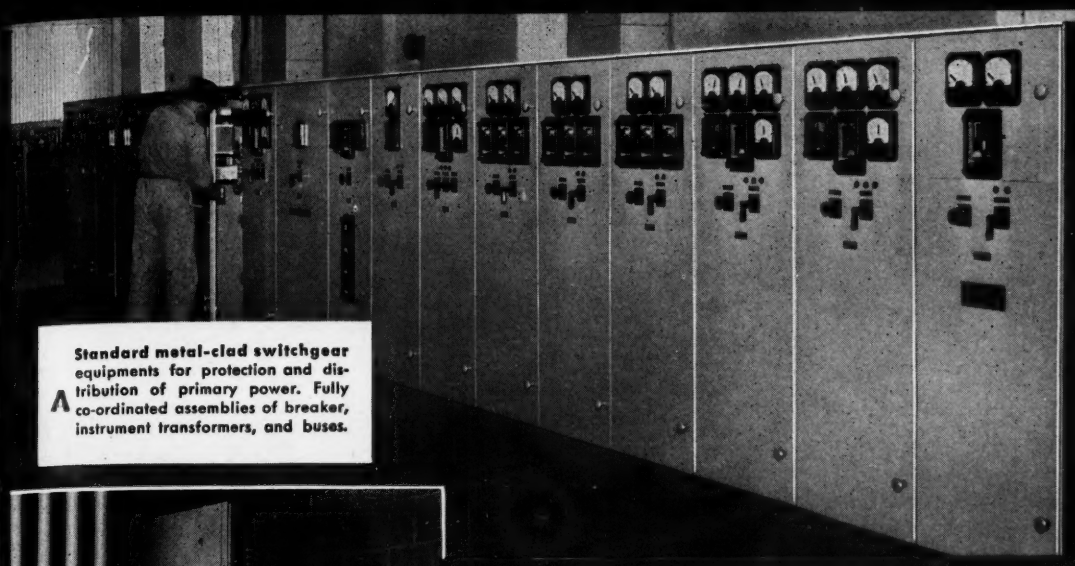
Many war-production factories are ordering plant distribution equipments at an early stage of construction by taking these three simple steps:

1 *Calculate the total kva you need.* Your consulting engineer can help you to determine this accurately.

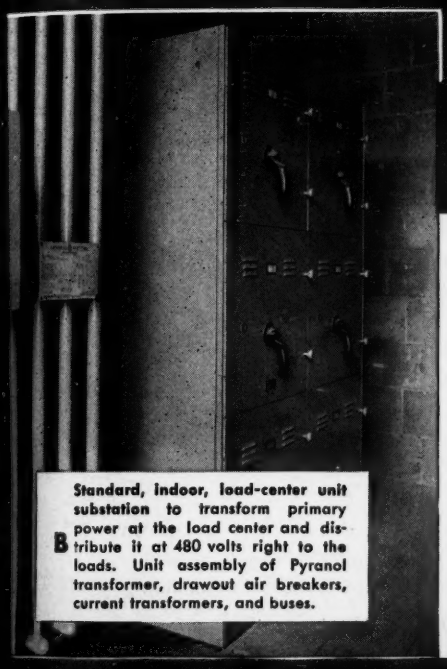
2 *Divide the load area into separate load zones of 500, 750, or 1000 kva each.*

3 *Divide the load of each zone into feeder loads,* and draw a one-line diagram of your proposed load-center system, giving the functions to be performed and the ratings required. *With this one-line diagram you can immediately order standard G-E switchgear equipments and unit substations.*

For further aid, ask for our new bulletin, No. GED-1006.



A Standard metal-clad switchgear equipments for protection and distribution of primary power. Fully co-ordinated assemblies of breaker, instrument transformers, and buses.



B Standard, indoor, load-center unit substation to transform primary power at the load center and distribute it at 480 volts right to the loads. Unit assembly of Pyranol transformer, drawout air breakers, current transformers, and buses.

MONTHS SAVED BY ORDERING STANDARD EQUIPMENTS

STANDARD G-E load-center power units were ordered for this war plant soon after construction started. A simple one-line diagram like that at the left put our factory right to work. Metal-clad switchgear and unit substations were installed in *one-fourth* the time needed for non-standard, piecemeal assemblies. They were received at the job when needed—all ready to be set in place and connected.

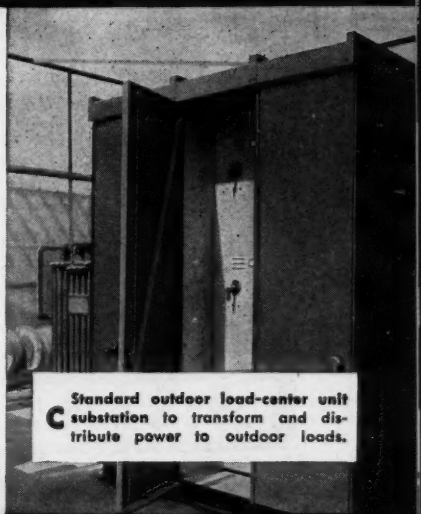
On this page are views of a few of these standard equipments—installed. They are typical of G-E load-center equipments that are being installed quickly and easily in plants everywhere. Note the metal-enclosed construction that safeguards workmen and production.

TONS OF COPPER SAVED BY LOAD-CENTER POWER DISTRIBUTION

ENGINEERS for this new war plant saved 145 tons of cable copper by taking high-voltage power right to the load centers, as shown at the left. In addition, they got a power distribution system that was so safe and efficient that, when need for additional capacity suddenly arose, they ordered another, a *duplicate* system—and saved another 145 tons of copper.

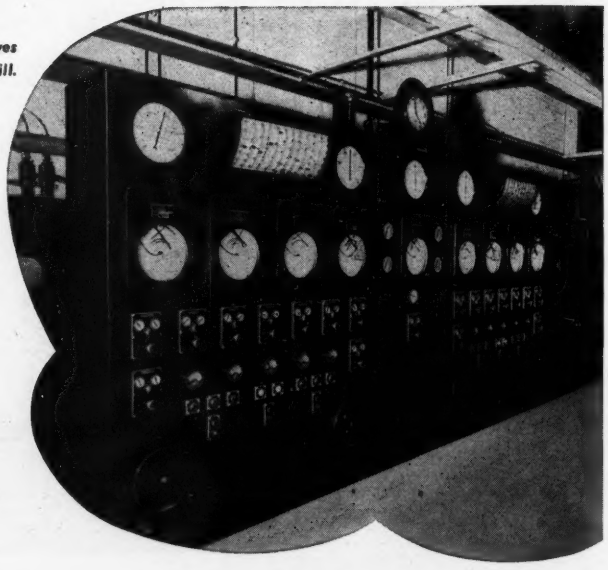
What's more, it took less copper to *build* these standard metal-clad units. The switchgear equipments shown at the top of this page took but 47 pounds of copper each. An open-type, piece-meal assembly would have taken more than four times as much.

If you need electric power for a new, enlarged, or converted war plant, we know you'll be pleased to learn how much copper and other critical materials you can save by using these standard load-center equipments. You'll find, too, that you can get them on the job quickly, and obtain a new high degree of safety and operating dependability. The nearest G-E office is ready to help you. *General Electric, Schenectady, New York.*



C Standard outdoor load-center unit substation to transform and distribute power to outdoor loads.

GENERAL ELECTRIC



This Bailey Boiler Control Panel serves multi-fuel fired boilers in a Steel Mill.

Boiler Control SPEEDS PRODUCTION for WAR and Peace

★ The same Bailey Boiler Control which is today helping American industry to deliver a flood of war material will continue to serve its users after the war.

When raw materials again flow to the goods of peace, this complete boiler control system will help many fortunate manufacturers to produce better products at lower cost.

But now, Bailey Control serves the war effort by:

1. Improving Continuity of service by continuously maintaining Combustion, Feed Water Flow, Steam Temperature, Heater Levels, Pump Pressure and other factors at optimum values.
2. Making full boiler capacity available by continuously and automatically maintaining excess air at the minimum economical value and by indicating when cleaning or repairs are necessary for boilers and furnaces.
3. Automatically maintaining ideal conditions while new boiler operators are in training.
4. Easing of transportation loads by the economical use of fuel which results from a coordinated control system.
5. Protecting men and equipment against accidents by the use of interlocks and alarms in the boiler control system. Serious accidents resulting from fan failure, flame failure, high or low water levels and other unusual conditions may be avoided by these devices.

Numerous suggestions on War Time Boiler Plant Operation are contained in the bulletin, "How to Safely Stretch Steaming Capacity." To obtain a copy, simply ask for Bulletin No. 16. A-85-1

BAILEY METER COMPANY
1040 IVANHOE ROAD • CLEVELAND, OHIO
Bailey Meter Company Limited, Montreal, Canada

BAILEY METER CONTROL

The Complete Combustion Control System

BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERHEAT CONTROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL

Purring like a kitten today—
BUT RUST MAY STRIKE TOMORROW!
Right now rust can be working on the delicate governor mechanisms of your turbines . . . then without warning—trouble! To help prevent costly shutdowns and overhauls change over your turbines to *new* Shell Turbo Oil—it can prevent rust! The first turbine oil to meet all 3 vital requirements of modern turbine lubrication, it offers
RUST PREVENTION
SUPERIOR OXIDATION STABILITY
MINIMUM FOAMING TENDENCY
Why accept less? Call in Shell today!
Keep YOUR turbines humming with
SHELL TURBO OIL
SHELL

BE SURE YOU HAVE YOUR COPES EQUIPMENT DIRECTIONS HANDY

● In these hurried times we pause to suggest a little "ounce of prevention" assistance. Every COPES Regulator, Pump Governor, Differential Valve, Desuperheater, Reducing Valve is covered by a book of instructions for its care and maintenance. Changes in personnel calling for new men at vital power plant positions may also call for a new COPES Book to replace the original that may have been mislaid.

● We ask the thousands of COPES users to check carefully and to make sure they have COPES equipment instructions handy. ● *Request on company letterhead, please.*

Book 44B— Operation of COPES Flowmatic with Direct Operated Valve

Book 30A— Operation of COPES BI Regulator

Book 43— Operation of COPES SL Pump Governor

Book 42— Operation of COPES 3-S-2 Differential Valve

Book 34E— Operation of COPES OT Regulator

Book 46E— Operation of COPES Flowmatic with Relay Operated Valve

Book 38C— Operation of COPES BI Regulator

Book 40B— Operation of COPES DA-2 Regulator

Book 31B— Operation of COPES SS Differential Valve

Book 33C— Operation of COPES D.S. Pump Governor

OVER 60,000 COPES FEED WATER REGULATORS IN SERVICE

NORTHERN EQUIPMENT COMPANY • *922 Grove Drive, Erie, Pa.*

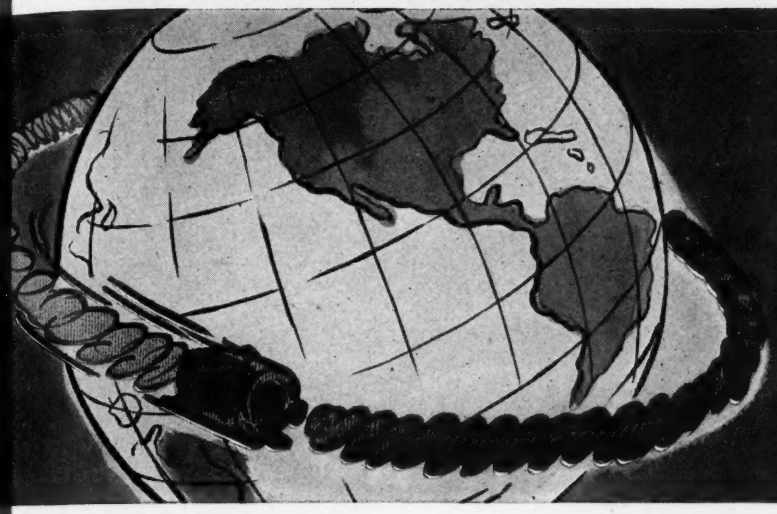
Feed Water Regulators • Pump Governors • Differential Valves • Liquid Level Controls
Reducing Valves • Desuperheaters

BRANCH PLANTS IN CANADA, ENGLAND • REPRESENTATIVES EVERYWHERE

★ GET CLOSER LEVEL CONTROL WITH THE COPES FLOWMATIC ★ REGULATOR

FEEDS BOILER ACCORDING TO STEAM FLOW • AUTOMATICALLY

Wartime Problems



ROUND THE WORLD EVERY 8 DAYS!

That's the rim-travel of a rotor in many electric motors now working all around the clock on Victory production!

Motors that worked 1800 hours in a peacetime year are now working a full *8700 hours a year.* Result: problems of maintenance are *quadrupled.* And more...

For motors must receive *finer* care than ever. Whose motors last longest may have a lot to do with who *wins* this war!

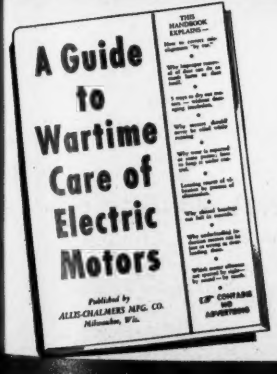
CALL FOR Wartime Solutions

AN ATTACK IS THE BEST DEFENSE

Taking the initiative against wear always has been sound maintenance practise. In wartime, it's a *vital* practise!

First, because wear now works *faster.* Second, because avoidable breakdowns *cannot be afforded* in the victory effort!

Beating wear to the punch is the basic principle of a new Allis-Chalmers publication: "A Guide to Wartime Care of Electric Motors." You'll find it *invaluable!*



Order This Free Book!

Every engineer, production manager and maintenance man will want a copy of "A Guide to Wartime Care of Electric Motors" for his technical library—and for immediate use, too!

It outlines the "natural enemies" of an electric motor and the most effective methods of combatting them. To be of maximum use to you, it applies to *all makes* of standard, general-purpose motors.

It's liberally illustrated — contains no advertising.

Tear out the order form now and send in to Allis-Chalmers for *your* free copy of this timely handbook.

ALLIS-CHALMERS MFG. CO.
Advertising Dept.
Milwaukee, Wisconsin

Gentlemen:

Yes, I would like to receive *free of charge* "A Guide to Wartime Care of Electric Motors."

Name:.....

Title:.....

Company:.....

Street Address:.....

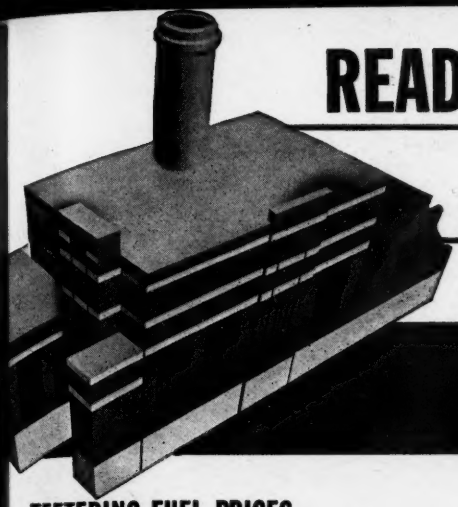
City and State:.....

A 1535-10

WE WORK FOR VICTORY WE PLAN FOR PEACE

HOLLAND, MICH.
LAWRENCE, KANS.
HANNIBAL, MO.
FULTON, MO.
FREMONT, NEB.
WINNETKA ILL.
MUNICIPAL LIGHTING PLANTS
Profit with
HAYS
automatic-centralized
COMBUSTION CONTROL
The aim of municipal lighting plants and public utility companies is to manufacture electricity at the lowest possible cost. They have found that one of the greatest cost savers is automatic combustion control. Many have found also that HAYS centralized control is simple to install, understand and maintain. A few of these are illustrated. What is good for the utilities is good for your power plant: cost saving is a necessity with any steam generating plant.
Write for further data.
THE MODERN SYSTEM
it's Electrical!
The HAYS CORPORATION
SINCE 1901
COMBUSTION INSTRUMENTS AND CONTROL
MICHIGAN CITY, INDIANA, U.S.A.

READ THESE SOLID FACTS ABOUT WATER-COOLED STOKERS



TYPICAL EXPRESSIONS BY USERS OF TAYLOR WATER-COOLED STOKERS

"OUR WATER-COOLED STOKER IS VERY RELIABLE AND FLEXIBLE WITH LOW MAINTENANCE AND HIGH AVAILABILITY WHILE BURNING A LOW GRADE OF FUEL THAT CANNOT BE BURNED SUCCESSFULLY ON AN AIR-COOLED STOKER."

"WATER-COOLED STOKERS VERY SATISFACTORY TO DATE. FUEL FLEXIBILITY ESPECIALLY GOOD. MAINTENANCE LOW."

TEETERING FUEL PRICES, STACK DISCHARGE, AND LOAD "SWING" BRING DECISION TO WATER-COOLED STOKERS

A certain mid-west plant had to be prepared for burning eastern or Indiana fuels as decreed by slight variations in price. Needed, too, was equipment capable of efficiently following the typical "swings" of municipal loads . . . and minimum stack discharge.

Bids for all types of firing were carefully examined. Taylor Water-Cooled Stokers presented, through examples of actual operation, the most acceptable solution. Thus Taylor Water-Cooled Stokers were installed under a 100,000 lbs. per hour steam generator.

The Results Speak for Themselves

Period	March 14, 1939 to Dec. 31, 1941 Incl.
Total steam generated	1,308,454,600 lbs.
Total coal burned	154,901,500 lbs. (77,450.75 tons)
Average actual evaporation	8.44 lbs. S/lbs. Coal
Operating conditions	435 lbs. G.; 700° T.T. 280° Feed to Econ.
Average heating value of coal	11,340 B.T.U. (as fired)
Combined efficiency	82.6%
Material cost for stoker maintenance	$922.93
Material cost per ton of coal burned	$ .0119

Characteristics of Coal

Moisture	8.5 to 11.5%
Ash	9.0 to 11.7%
Sulphur	2.9 to 3.98%
Fusion temp. ash	2076 to 2230° F.

427 Mile Freight Train!

It would require a freight train approximately 427 miles long (stretching from Cleveland, Ohio to Philadelphia, Pa.) to haul the 2,700,000 tons of coal required for the annual operation of Taylor Water-Cooled Stoker installations.

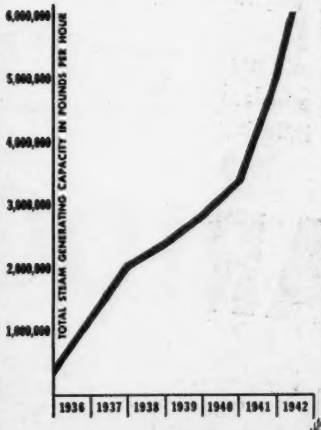
You Gain at Least 3 Ways

by using Taylor Water-Cooled Stokers:

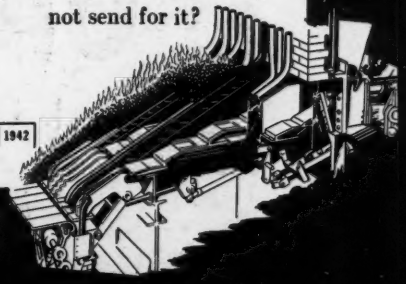
1. Increased reliability.
2. Increased fuel flexibility.
3. Higher operating efficiency.

But there are many more advantages told in Catalog W which the coupon will bring to you. Mail this coupon.

Follow the Rise of Water-Cooled Stoker Sales



This chart tells you at a glance how power plant operators feel about the Taylor Water-Cooled Stokers. Many of the reasons for their enthusiasm are found in Catalog W, offered below Why not send for it?



A-E-CO TAYLOR WATER-COOLED STOKER

AMERICAN ENGINEERING COMPANY
2408 Aramingo Avenue, Phila., Pa.

Send me without obligation a copy of the 8-page Catalog W describing Taylor Water-Cooled Stokers.

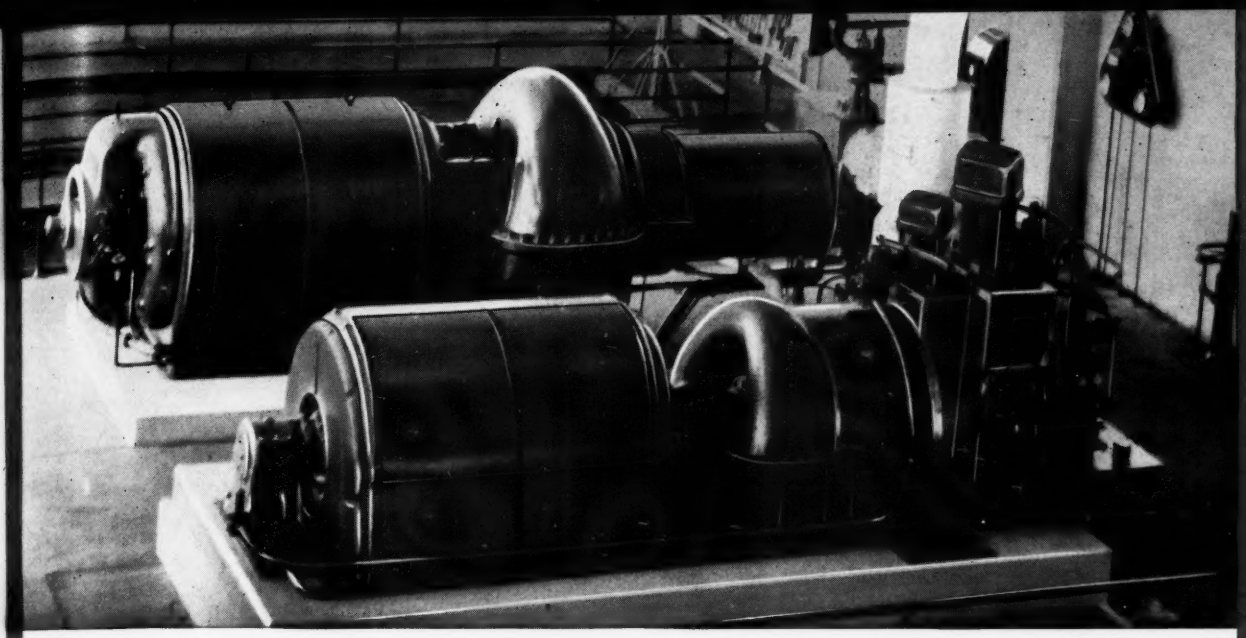
*Name*_____

*Company Name*_____

*Address*_____

*City*_____ *State*_____

WE MUST WIN THIS WAR
To win the war—and the peace that follows—we must maintain efficient production in all industrial plants. Every man-hour and every machine-hour counts!
Garlock continues to make packings, gaskets and oil seals which give long, dependable service. They help industry maintain full production schedules.
GARLOCK
THE GARLOCK PACKING CO.
PALMYRA, N. Y.
In Canada:
The Garlock Packing Co.
of Canada Ltd., Montreal, Que.



NOW, MORE THAN EVER, YOU NEED THE

Protection OF NONPAREIL TURBINE OIL

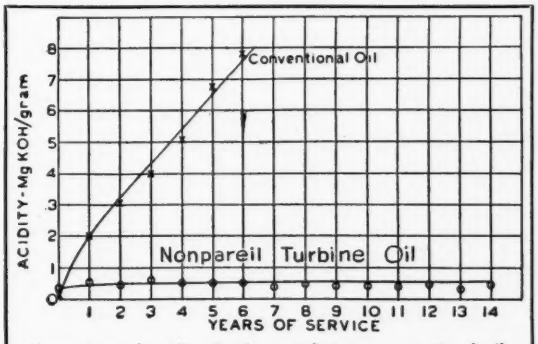
- **Protection against shutdowns for cleaning governors and turbine oil system.**
- **Protection against bearing corrosion and excessive wear.**
- **Protection against formation of oil sludge and emulsions.**

SUCH PROTECTION definitely contributes to your all-important Victory effort to increase power output with less labor and maintenance. There are several reasons why Nonpareil gives you this added protection.

Nonpareil is a highly refined white viscous oil with asphaltic constituents removed and certain patented inhibitors added to retard oxidation and formation of acidity.

The chart at right shows a comparison between acidity formation in conventional turbine oils and in Nonpareil, taken from records on hundreds of turbines. From similar data, it was determined that Nonpareil would last indefinitely in a turbine without oxidizing to produce high acidity, sludge formation, and loss of demulsibility.

Nonpareil Turbine Oil is the only oil *guaranteed in writing* to last as long as your turbine. Let a Standard Lubrication Engineer fully explain this guarantee and what it may mean to you. Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago, Illinois, for the Engineer nearest you.



Comparison of acidity development between conventional oils and an inhibited turbine oil (Nonpareil) on all types of service. It shows the superior resistance to acid formation of Nonpareil even after 14 years of service.

OIL IS AMMUNITION — USE IT WISELY

STANDARD OIL COMPANY (INDIANA)

LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION ENG

UBRICATION ENGINEERING • • LUBRICATION ENGINEERING • • LUBRICATION EN

HERE'S HELPFUL INFORMATION ON LUBRICATION AND LUBRICANTS

You may have taken over new duties—new men may have been assigned unfamiliar jobs. Where lubrication is concerned, these Engineering Bulletins will be helpful. They are briefly described below. Send for any you think will be valuable to you or your men.

Where you have specific lubrication problems, call a Standard Oil Engineer. He will have information on the latest developments in methods to solve your problem.

1 "POWER TRANSMISSION EQUIPMENT AND ITS LUBRICATION"

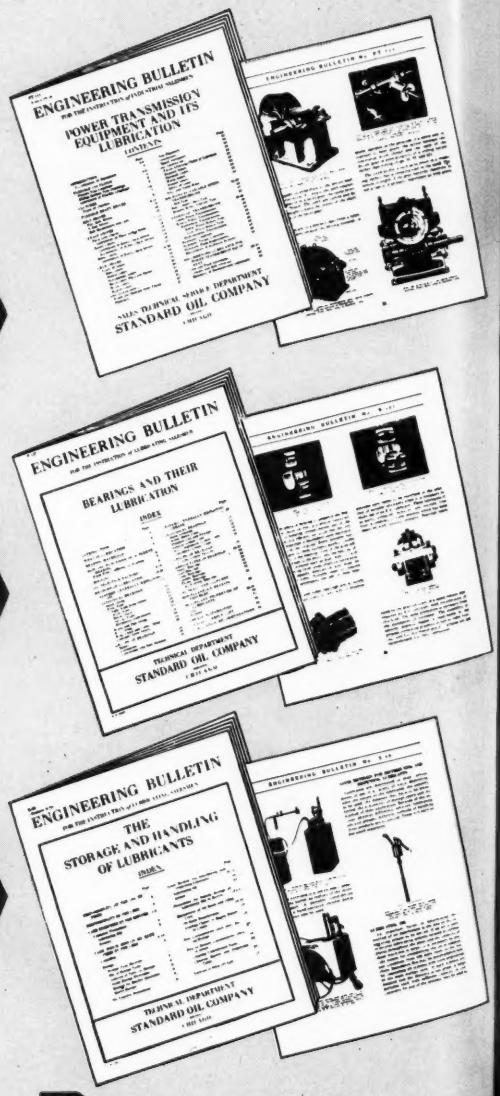
Discusses the design of various types of drives and the important factors to be considered in their lubrication to prevent excessive wear and maintenance. This not only includes the conventional chain and gear drives but also variable speed and hydraulic transmissions.

2 "BEARINGS AND THEIR LUBRICATION"

Discusses types of bearings and bearing materials—types of lubricants required by each of them—methods of lubrication—significant properties to be considered in selecting an oil or grease.

3 "STORAGE AND HANDLING OF LUBRICANTS"

Describes various causes of contamination of lubricants in storage and suggests ways to avoid it. Methods of oil room management are suggested, as well as ideas for distributing and dispensing lubricants to avoid mixing brands in application.



OIL IS AMMUNITION . . . USE IT WISELY

STANDARD OIL COMPANY (INDIANA) — Power Plant Engineering
910 SOUTH MICHIGAN AVENUE—ROOM 1223
CHICAGO, ILLINOIS

Please send me Bulletin number .....

Name .....

Company .....

Address .....

City and State .....

PASTE THE COUPON ON A POST CA

Copies will be sent free if you are located in on the states listed below—or phone the nearest Sta ard Oil Company (Indiana) office in these states

COLORADO • ILLINOIS • INDIANA • IOWA • KAN
MICHIGAN • MINNESOTA • MISSOURI • NORTH DAK
MONTANA • SOUTH DAKOTA • WISCONSIN • WYOM

In Nebraska, write Standard Oil Company of Nebras at Omaha.

CATION

STANDARD OIL COMPANY (INDIAN

MIDWEST

THE COMPLETE LINE OF Welding Fittings

Many users of welded piping are finding it advantageous to standardize upon Midwest Welding Fittings. Important among the reasons for this preference is the fact that only one source of supply is necessary to meet all their needs. . . . Midwest has the most complete line of welding fittings.

Midwest was the first manufacturer to recognize the need for many of the fittings illustrated here. Reducing Elbows, Saddles, Sleeves, "Long Tangent" Elbows and Shaped Nipples are among the fittings developed by Midwest and first offered to the trade by Midwest.

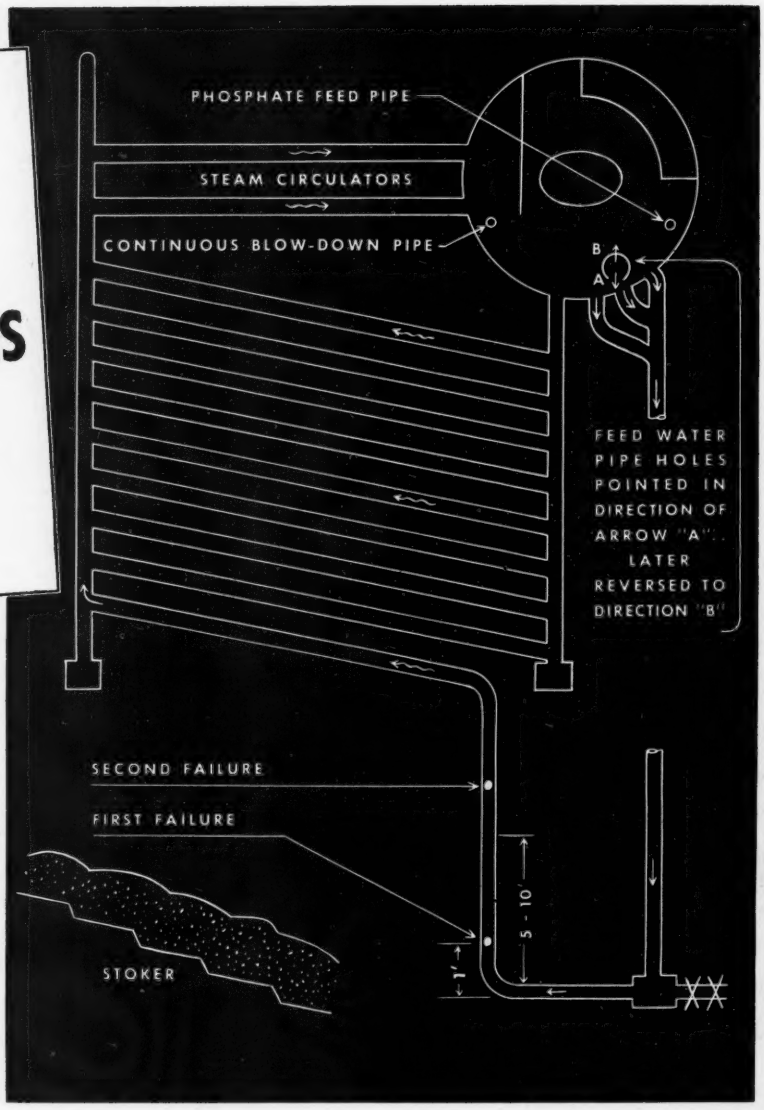
The design and method of manufacture of Midwest Welding Fittings offer the user definite advantages . . . such as exceptional dimensional accuracy. (See Bulletin WF-41 for details.)

MIDWEST PIPING & SUPPLY CO., Inc.

Main Office: 1450 So. Second St., St. Louis, Mo.
Plants: St. Louis, Passaic (N. J.) and Los Angeles

Sales Offices: Chicago—849 Marquette Bldg. • New York—(Eastern Division) 30 Church St.
Los Angeles—520 Anderson St. • Houston—229 Shell Bldg.
San Francisco—535 Call Bldg. • Tulsa—533 Mayo Bldg.

NEW BOILER BURNS OUT TWICE IN 6 WEEKS ...WHY?



WHY should a new boiler rated at 65,000 lbs. of steam per hour and 420 lbs. pressure burn out 4 tubes low down in the rear water wall during the first month? First thought—maybe it was too frequent blowdown of the rear water wall.

Then why, after locking the blowdown connections and welding in new tube sections, should seven tubes fail higher up within just two weeks of operation?

Was it caused by untreated water reaching the affected tubes? The plant staff didn't think so. Their tests showed nothing wrong. The boiler drum and visible tubes were clean as a whistle.

Having done what they could, they sent for a Hall Service Engineer. His examination showed no unusual conditions in tubes or drum. The boiler was in excellent shape. Then a section of one of the bagged tubes was cut out. In this was found an extremely thin, brittle coating of a grayish crystalline scale. Analysis showed largely calcium sulphate and a small amount of calcium carbonate. That could mean only one thing — untreated water *was* reaching the affected tubes. But how?

He inspected the drum again. This time he noted that the holes in the boiler feed pipe were directed downward. If untreated feed water was reaching the tubes, this was a way it could do it.

Then he checked the boiler blueprints. Sure enough, the feed holes should have been directed upward. Here was the needle in the haystack. He rotated the pipe 180°. That was months ago. There has been no more trouble with burnt out tubes.

There you have another of the thousands of cases where a Hall Engineer working with the plant staff keeps boilers on the line, another proof of the value of expert engineering knowledge in connection with water conditioning service.

Never has a protective boiler water conditioning service of this kind meant more to you than now. Why not ask us to explain it to you?

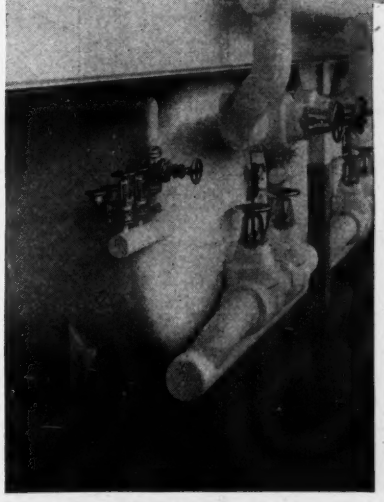
HALL LABORATORIES, INC. · 300 ROSS STREET · PITTSBURGH, PA.

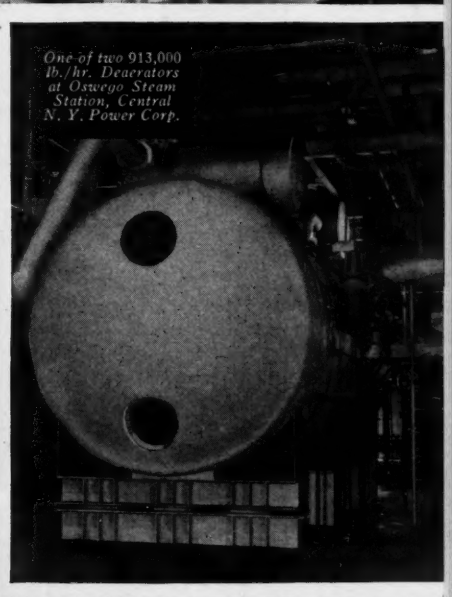
HALL SYSTEM *of Boiler Water Conditioning*

Cochrane Water Conditioning Saves Money and Speeds Production, in War as in Peace:

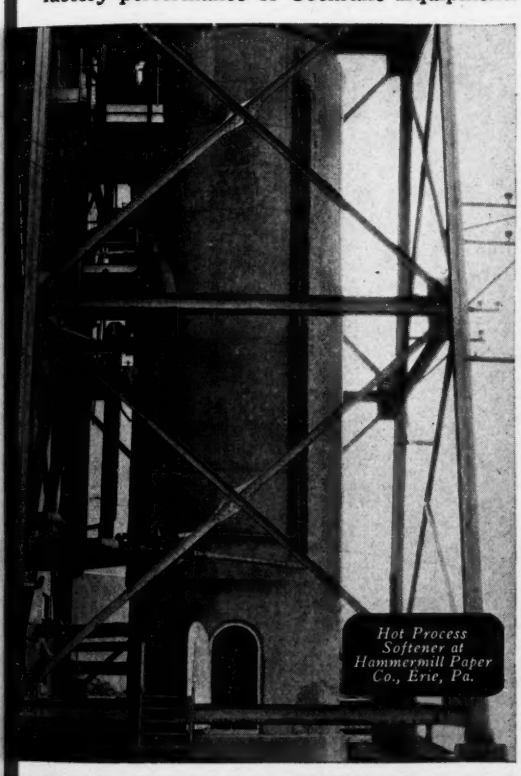
Complete conditioning of water and steam for industrial plants is the specialized field in which Cochrane has been engaged for half a century. A wealth of installations testify to the satisfactory performance of Cochrane Equipment.

Two 32,000 GPH Deaerating Hot Process Softeners at Ford Motor Co., Dearborn, Mich.

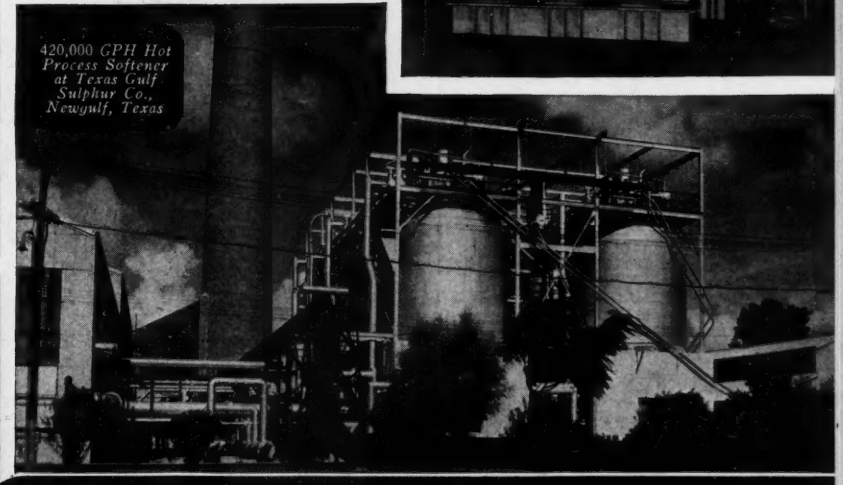




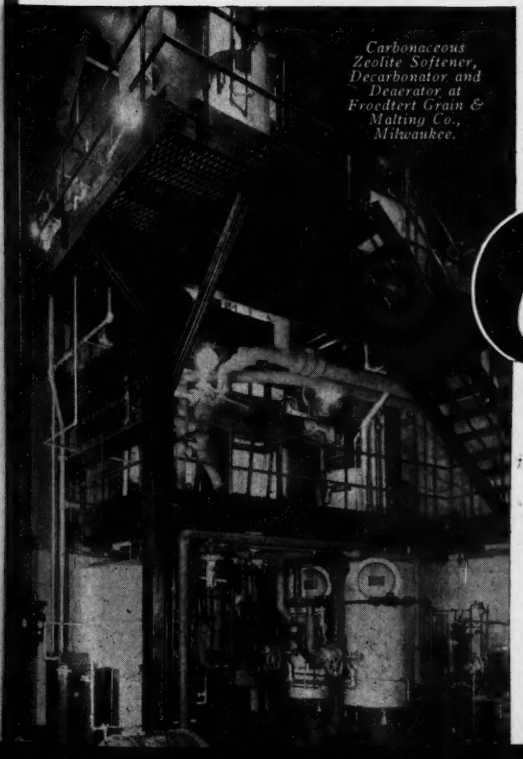
One of two 913,000 lb./hr. Deaerators at Oswego Steam Station, Central N. Y. Power Corp.



Hot Process Softener at Hammermill Paper Co., Erie, Pa.



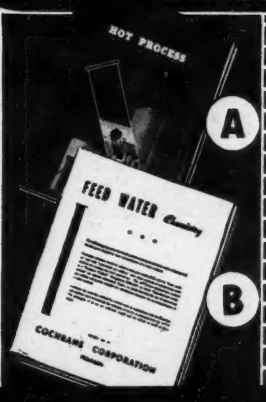
420,000 GPH Hot Process Softener at Texas Gulf Sulphur Co., Newgulf, Texas



Carbonaceous Zeolite Softener, Decarbonator and Deaerator at Froedtert Grain & Malting Co., Milwaukee.

Cochrane Corporation

3106 N. 17th ST. PHILADELPHIA, PA.



Cochrane Corp., 3123 N. 17th Street, Philadelphia, Pa.

Please send copies of the publications checked below:

A ☐ Publication 3000. Cochrane Hot Process Softener. Catalog.

B ☐ FEEDWATER Chemistry.

Name .....

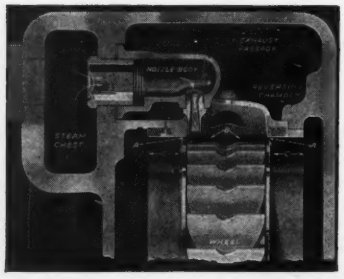
Position .....

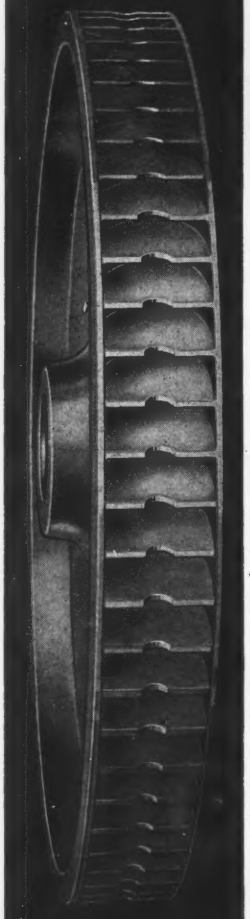
Firm .....

Address .....

City ..... State .....

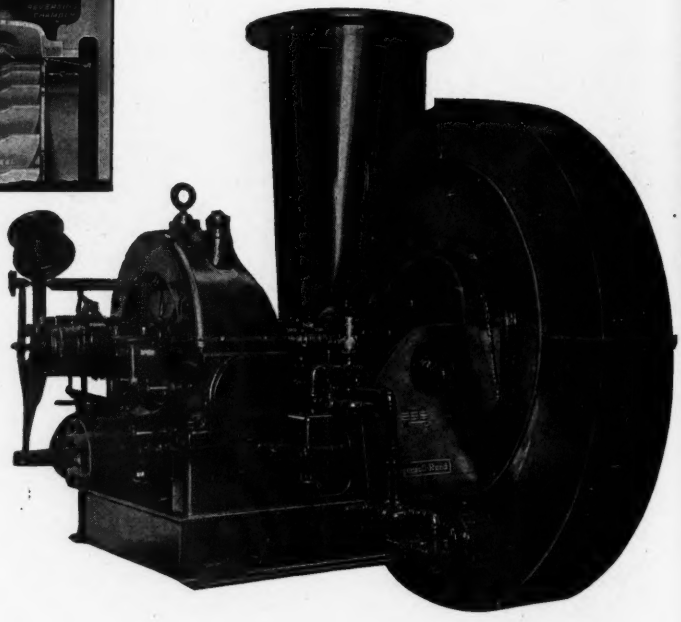
TERRY





ABOVE:
Terry Wheel Clearances. A-Rim Clearance. B-Large Blade Clearance. C-Side Clearance (about one inch)

AT RIGHT:
Typical Terry Solid Wheel Turbine direct connected to a blower.



THE BLADES ARE DOUBLE RIM PROTECTED
IN THE TERRY SOLID WHEEL TURBINE

In the Terry Turbine the blades have large clearances and are further protected by the projecting rims at the sides of the wheel. These rims would take without damage any rubbing that might occur if the radial clearance became reduced.

End play can do no damage to the blading as the side clearance is very large (about one inch). There is no end thrust since the steam enters and leaves the wheel in a direction at right angles to the shaft.

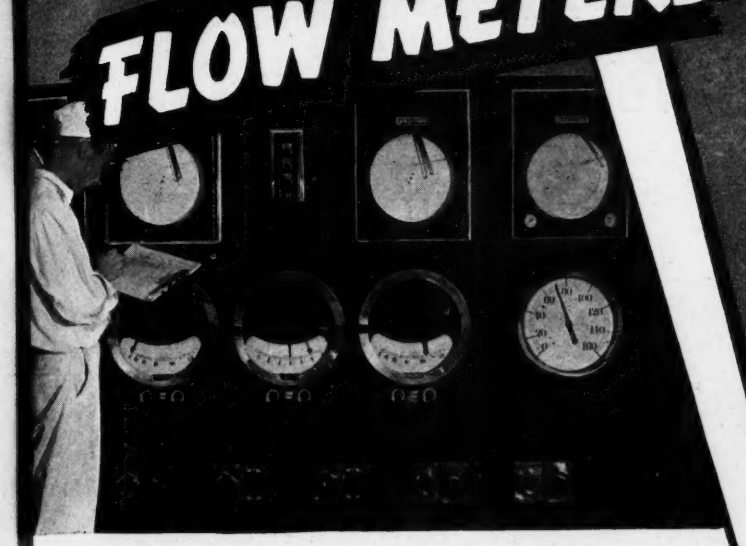
The Terry solid wheel turbine is described in our Bulletin S-116. A request on your business letterhead will bring a copy.

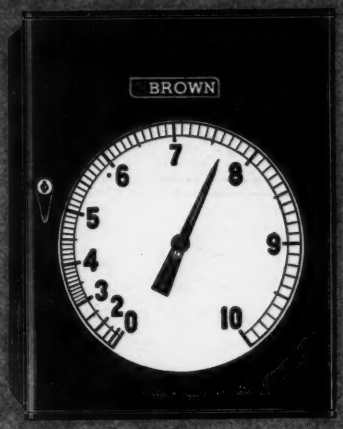
T-1146

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

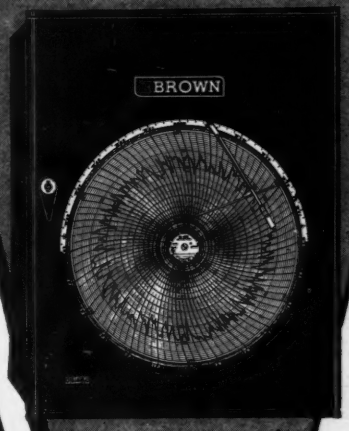
BROWN FLOW METERS

. . . SECURE EFFICIENT POWER PRODUCTION

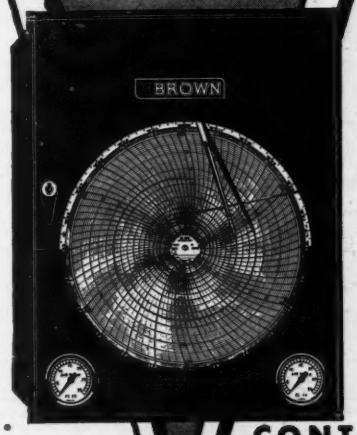




INDICATING



RECORDING



CONTROLLING

TO win the war—It is a patriotic duty to *eliminate waste of power.*

To produce and use power more efficiently is the object of every industrial operation. For that purpose, good managers keep chart records of steam, air, oil, gas, water and other fluids.

Whether you buy steam or generate it in your own plant—every pound of steam saved—not only in the boiler room but in every department or unit where steam is used—assures Victory.

With Brown Flow Meters, you can correctly determine the cost of making steam for power, processing or heating and properly allocate costs to departments or units. Brown Flow Meter chart records show the rate of steam flow which enables operators to maintain the most efficient boiler operation, thus effecting substantial fuel savings.

An automatic planimeter pen record on rim of chart shows steam flow in volume units and the time at which it was produced or used in any part of the 24 hour period, and enables management to readily analyze steam production and distribution.

Thousands of plant engineers are getting this invaluable service from Brown Flow Meters. In many plants, the investment for Brown Indicating, Recording and Controlling Flow Meters has been repaid many times over. Write for catalogs.

For Temperatures . . . . . Pressures . . . . . Flows . . . . . Liquid Levels

BROWN INSTRUMENTS

ELECTRIC • AIR OPERATED

THE BROWN INSTRUMENT COMPANY, 4491 WAYNE AVENUE, PHILADELPHIA, PENNSYLVANIA
DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR CO.
MINNEAPOLIS, MINNESOTA AND 119 PETER STREET, TORONTO, CANADA
Wadsworth Road, Perivale, Middlesex, England
Nybrokajen 7, Stockholm, Sweden

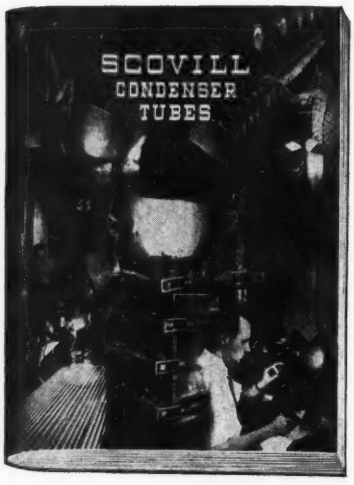
Suggestions for Prolonging Condenser Tube Service Life

Now, more than ever, condenser tube dependability and long life are factors of importance, both from the angle of uninterrupted service and the conservation of copper alloys.

In these respects, Scovill facilities will prove to be valuable to you, for Scovill offers one product—and three services.

The first service is *men*—Scovill engineers who can help you get the most out of your present tubes—then can suggest the most economical retubing alloy for your operating conditions. With a practical understanding of condenser and heat exchanger problems, these men can be of help to you on any problem pertaining to tube use. The service is free—we hope you will use it.

The second service is *manuals*. Have us send you a copy of the Condenser Tube Booklet illustrated—a source of valuable information on prolonging condenser tube service life. Write Scovill Manufacturing Company, 17 Mill Street, Waterbury, Connecticut.



The third service is *metals*. Scovill has a condenser and heat exchanger tube alloy to meet every need where a nonferrous alloy tube can be used:

MUNTZ METAL

For steam condensers and other low-temperature, low-pressure heat exchangers where raw water is fresh and low in temporary and permanent hardness and in dissolved gases (CO_2 and O_2), as, for example, many locations on the Great Lakes and a few inland rivers.

COPPER

For steam condensers where fresh water is used, and particularly with relatively soft waters carrying high concentration of dissolved gases (CO_2 and O_2); where the conditions of operation are such as to cause "dezincification" in the brasses. Copper tubes are also frequently used in heat exchangers not requiring great physical strength and where sulphur compounds and oxidizing acids are absent. Pure copper softens at approximately 200° C.

Considering the importance of economizing the use of copper for the war program, we suggest your consideration of "Phosphorized Admiralty Tubes" (with their lower copper content) for installations where copper would normally be used.

ARSENICAL COPPER

The addition of the 0.15% to 0.75% Arsenic to pure copper raises

Scovill
MANUFACTURING COMPANY
WATERBURY, CONN.

SCOVILL
one product . .
SERVICE IN MANUALS..

its softening temperature so that it can be used in heat exchangers operating at temperatures up to 300° C. Hard drawn Arsenical Copper tubes have approximately the same strength as "finish annealed" Admiralty or Muntz tubes. They are usually supplied in the hard condition with ends annealed if necessary. Both laboratory tests and field service of this material indicate an improvement in corrosion resistance over previously used type of copper.

"Phosphorized Admiralty Tubes" will perform satisfactorily in most installations where Arsenical Copper is usually used. This substitution is particularly desirable now as "Phosphorized Admiralty" requires 30% less copper.

RED BRASS

For condensers and heat exchangers where it is necessary to combat "dezincification" and where acidity, if any, is of a low order. Red Brass is stronger and stiffer than copper and has excellent resistance to "dezincification" in fresh waters high in temporary and permanent hardness and in soft waters carrying high concentrations of dissolved gases (CO_2 and O_2).

"Phosphorized Admiralty Tubes" will also be a satisfactory material for these conditions. In the present tight copper situation, we suggest your use of "Phosphorized Admiralty" with its lower copper content.

ADMIRALTY

Regular

For condensers and other heat exchangers where raw water, whether fresh, brackish or saline, pure or polluted, ranges from moderately acid to alkaline. Regular Admiralty has excellent strength and ductility at temperatures up to 200° C. (390° F.) where a slight drop occurs.

"Phosphorized"*

Wherever dezincification of Regular Admiralty Tubes has been a corrosion problem, the use of Phosphorized Admiralty is suggested. This alloy combines the general excellent corrosion-resistant properties of Regular Admiralty, a desirable fine grain structure, and very marked resistance to dezincification. Several million pounds of Phosphorized Admiralty Tubes are now in service and reports of their ability to withstand both general corrosion and dezincification have been very favorable. (Priced the same as Regular Admiralty.)

ALUMINUM BRASS

In many installations where tube deterioration results from impingement (erosion-corrosion) attack, this alloy has proved superior to Admiralty. The alloy can be used with salt, brackish or fresh water at normal temperatures. The desirable corrosion-resistance properties probably result from the formation of a tough, thin, continuous film of aluminum oxide which forms on the exposed surface.

Principal uses to date and best performances have been in the marine field and tidewater plants where saline waters are encountered.

CUPRO NICKEL 70-30

Recommended for the most severe conditions in which copper alloys are serviceable. The protective film formation on this alloy is impervious, tough, and continuous. It protects against the chemical or electro-chemical action of the commonly encountered circulating media in power, petroleum, and other process plants. Erosion-corrosion resistance is of a high order.

*"Phosphorized Admiralty Tubes" for condenser and heat exchanger service are covered by patent 2,224,095 and can be legally supplied only by Scovill Manufacturing Company, the owner of this patent.

Condenser Tubes

. . . three services

SERVICE IN METALS . . . SERVICE IN MEN

INTERLOCKED is One Rod Packing that

Can't Come Apart

J-M INTERLOCKED—*the greatest single improvement ever made in braided packing*

Once Interlocked is installed, you can be sure that repacking jobs will be few and far between. This unique braided material has no jackets to wear through or come apart . . . no plaits to loosen. It is braided square, rather than pressed into shape, and thus presents a better contacting area . . . provides a tight seal with minimum gland pressure and take-up.

J-M Interlocked is provided in a variety of styles to meet a wide range of operating conditions. For details, and for facts on other money-saving J-M Packings and Gaskets, write for Catalog PK-12A. Johns-Manville, 22 East 40th Street, New York, N. Y.

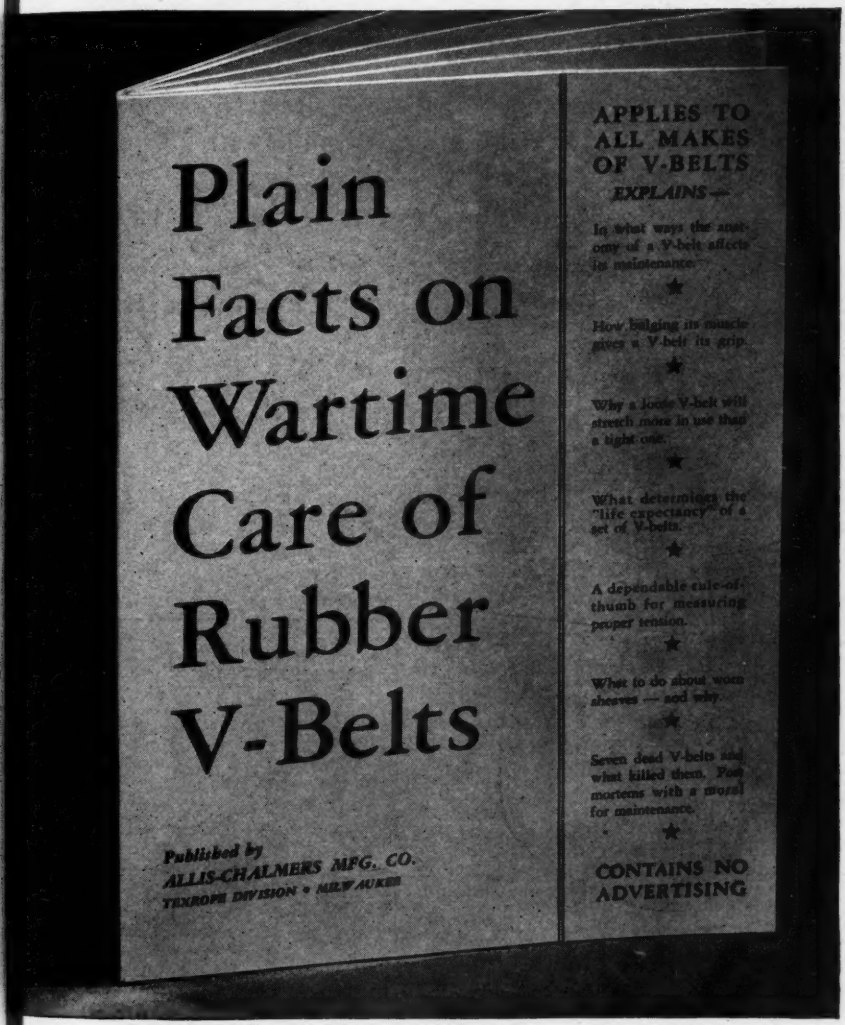
J-M Interlocked is available for prompt delivery . . . See your nearest J-M Distributor

JM PRODUCTS

Johns-Manville PACKINGS & GASKETS

ANNOUNCING ALLIS-CHALMERS' NEW

Wartime Guide to V-belt Care!


Plain Facts on Wartime Care of Rubber V-Belts
Published by ALLIS-CHALMERS MFG. CO. TEXROPE DIVISION • MILWAUKEE
APPLIES TO ALL MAKES OF V-BELTS
EXPLAINS—
In what ways the anatomy of a V-belt affects its maintenance.
How bulging its muscle gives a V-belt its grip.
Why a loose V-belt will stretch more in use than a tight one.
What determines the "life expectancy" of a set of V-belts.
A dependable rule-of-thumb for measuring proper tension.
What to do about worn sheaves — and why.
Seven dead V-belts and what killed them. Post mortems with a moral for maintenance.
CONTAINS NO ADVERTISING

It's free to every engineer, executive and maintenance man now concerned with raising V-belt performance to new wartime standards of efficiency. Rubber V-belts are a precious national asset! And here's the full, interesting story on how to make them work better, last longer than ever before. Send to Allis-Chalmers for this valuable new handbook today!

[PRINCIPLE OF THE V-BELT DRIVE]
Like Bending an Arm
..Bending a V-Belt
Bulges its Muscle!
HOW BULGING TENDENCY GIVES V-BELTS THEIR GRIP

FULLY ILLUSTRATED—It's packed with practical data...specially designed for training new men!

V-Day needs every V-Belt

FREE! Every engineer should have this important new handbook in his technical library. It applies to *all* makes of V-belts...contains no advertising. Tear out the order form and send it in *now!*

ALLIS-CHALMERS MFG. CO.
Milwaukee, Wisconsin

Gentlemen:

Yes, I would like to receive a *free* copy of "Plain Facts on Wartime Care of Rubber V-belts."

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Company: _____

Street Address: _____

City & State: _____

A 1551-12

ALLIS-CHALMERS

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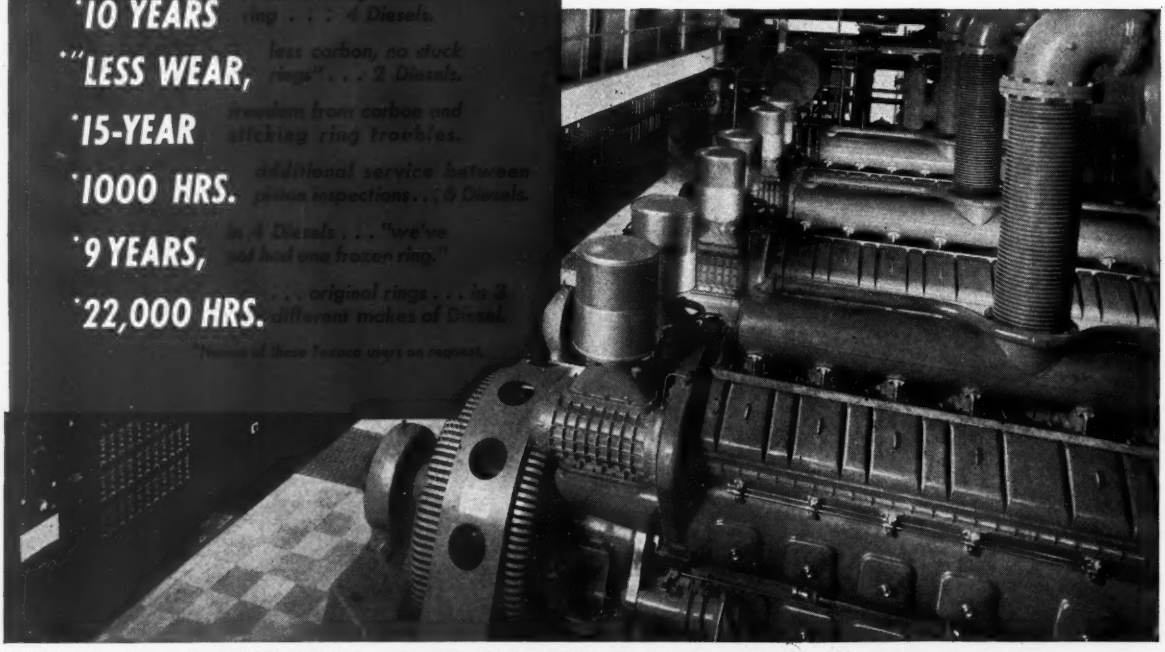

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POWER PLANT ENGINEERING

SEPTEMBER, 1942
VOLUME 46, No. 9

Cover: Engineer checking up on speed of electric generator. Photo, Hartford Steam Boiler Inspection and Insurance Co.

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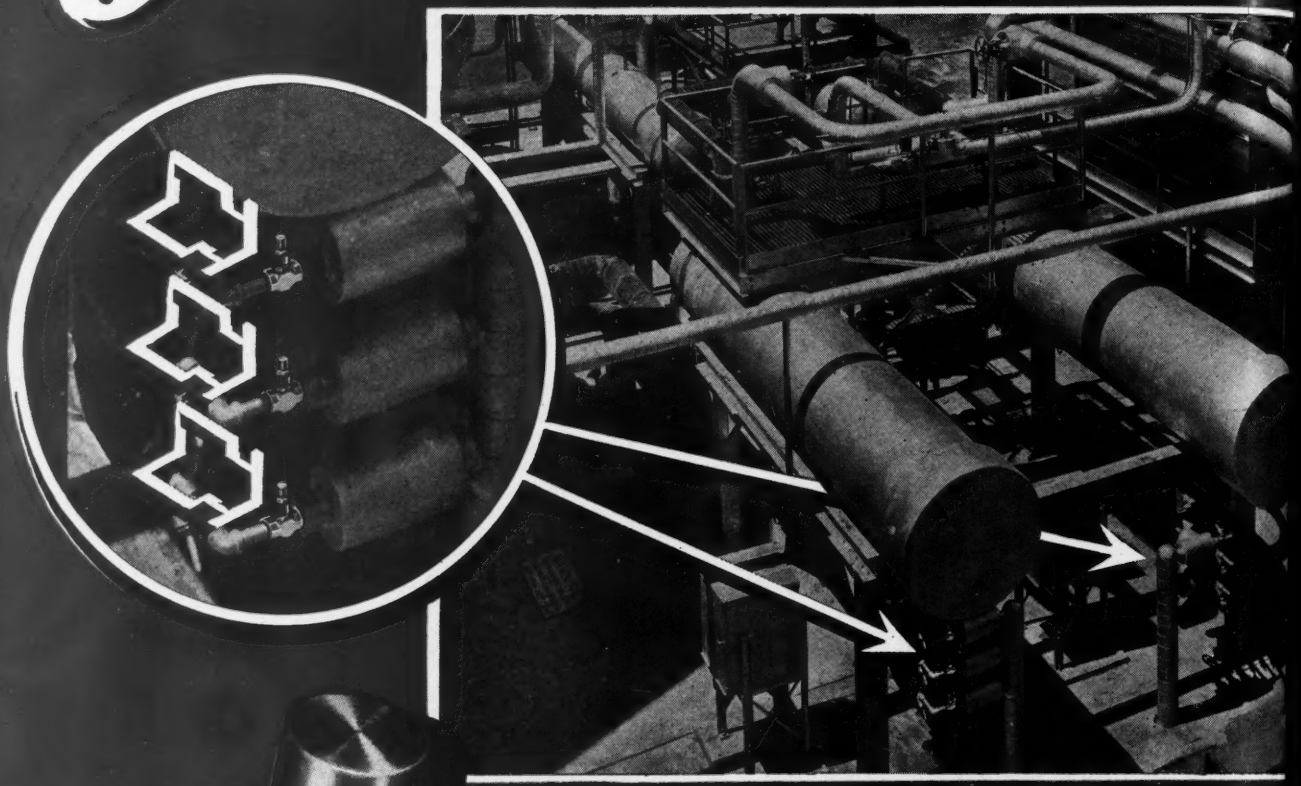
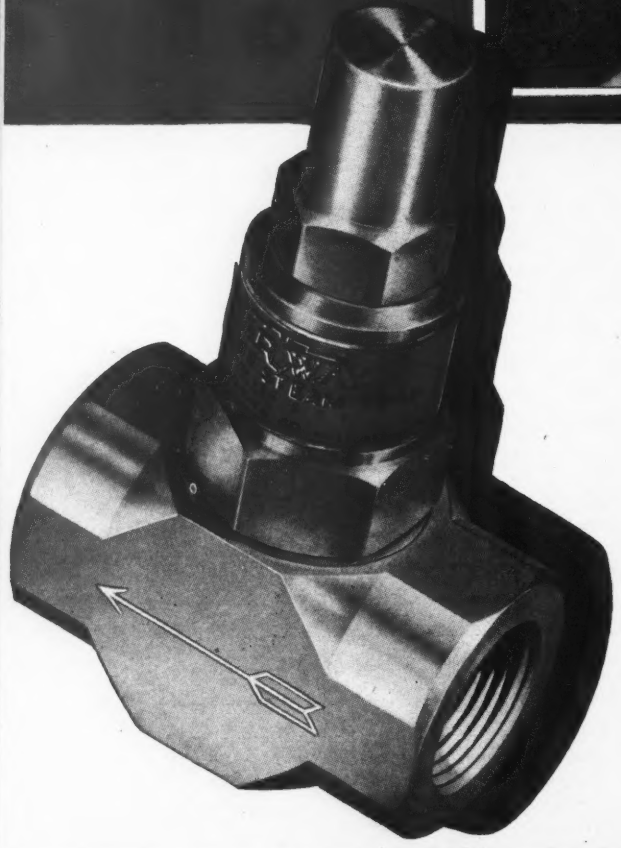
6 Little Traps Drain Big Heat Exchanger





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WHAT LEADERS SAY

Plant Problems in War Production

By FREDERICK B. HEITKAMP

IF WE READ the newspapers, the trade journals, magazines, and listen to the numerous informative talks on the radio we know that the present main manufacturing plants have already been filled with war orders; in fact, long before Pearl Harbor many of them were well filled. Other plants had to be entirely revamped, taking out the normal product, as in the case of the automobile industry. New tools had to be secured. New jigs and fixtures which were placed on these tools had to be made to adapt themselves to the new part. All of this required new planning, new layouts by men working on into the night and new training of personnel. But after a short time—much shorter than people realize, the main manufacturing plants of this country became loaded. Building new plants was the next thought, plants in which one product was built entirely from beginning to end. But looking at our total program we find that such existing and such new manufacturing capacity as has been created, is not enough to carry through this tremendous program toward which we have set our earnest efforts.

The nation has been compelled to turn to plant conversion, changing over from the manufacture of a normal product to a product which is used exclusively for war activities. But all plants were not able to take on prime or major contracts. So we find a new problem that is being solved by a combination of plant conversion and sub-contracting.

There is no great mystery to this sub-contracting program. All, or most large companies are now doing a certain amount of buying of units for final assembly, from other companies. That is, they are sub-contracting a certain amount of their parts. Even the largest of airplane plants has to secure "gadgets" from the outside, in order to complete the final assembly of their planes.

In the case of our company there was a definite indication over a year ago of a shortage of materials to make our normal product. This led to a decision to get lined up on war production. As we gradually reduced the manufacture of our normal product, we brought in the war work until now the main plant is producing far more on war products than it ever did in the normal period on its own standard product, made possible through the additional shifts, additional hours of work, additional efforts and intensified drive to get the work out.

How were we, as manufacturers of a normal industrial product, able to secure orders for war work? This was done by going to, and I mean seeking out, the Army and Navy Placement Bureau agencies where contracts were being let. We had to sell ourselves and our services and were successful in doing it. After that, through the reputation obtained in the initial effort, orders sought us out. Through the OPM coming to us and asking us to get facilities for certain products for prime contractors, we, in a sense, became a sub-contractor and in turn, sub-let ourselves.

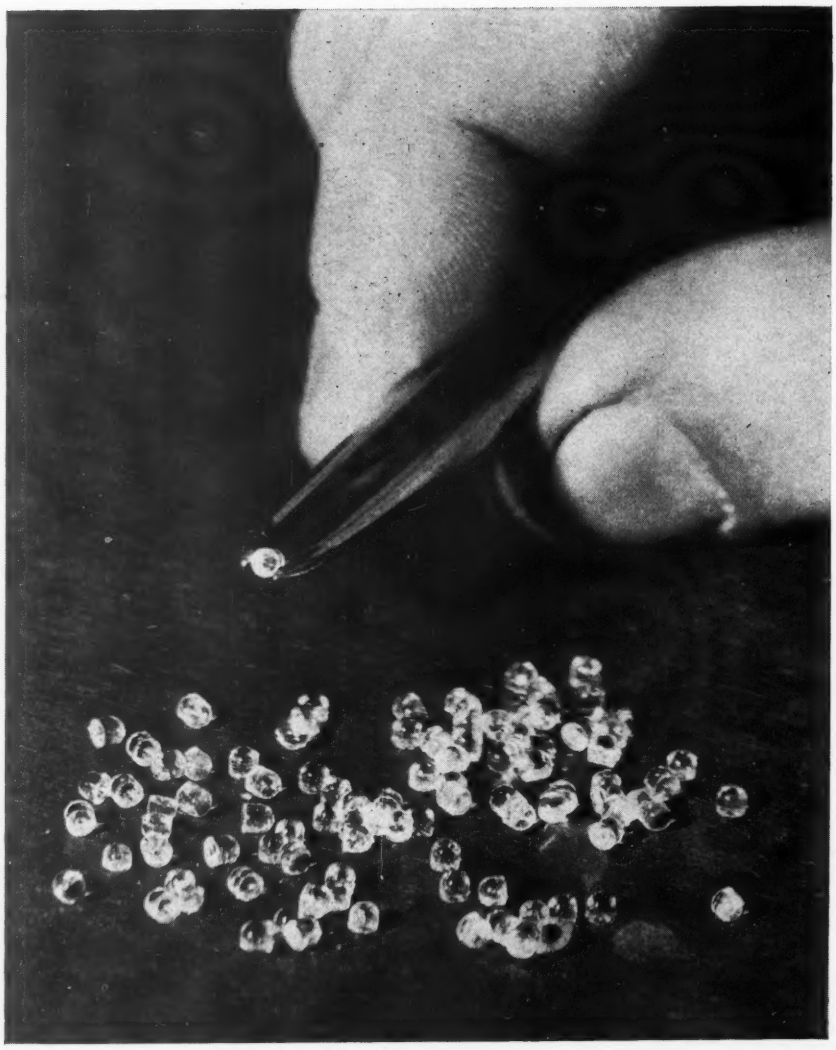
Sub-contracting depends upon efficient management. In the first place, having decided upon the product which is to be built and having obtained your drawings and blueprints and specifications which have been OK'd by the Ordnance Department, let us say, you must locate adequate sources of manufacture. This means the weeding out of a great many manufacturers who may want to do the job but who really are not set up to do it. When the sub-contractor has been finally selected even then it is necessary to help him on his production methods . . . even supply him with machine tools . . . even help him in the manufacture of jigs and gages and fixtures. In many of these plants it is necessary for us to place resident production engineers who will expedite the production, help on production difficulties, supervise the inspection and in general, represent us as a resident manager in that plant. He must be sure that all the parts that come out of that plant, pass the proper inspection qualifications so that when they come to our plant and go on our assembly line the parts will fit.

Why do we have all the headaches and why should there be any delay? Sub-contracting multiplies the normal type of manufacturing procedure several times. Any management would prefer to have under one roof all of the manufacturing problems. But multiply this by 43 different units, located in different geographical areas, all of which have had to convert from their normal product to a new product and you can see the difficulties that are involved. Furthermore, sub-contractors must be supplied with materials, sources of supply for castings, forgings, bar stock, and raw materials located. We have had to establish the proper contacts with the Ordnance Department and with the government to set up a means of inspection supervision by local Ordnance Departments in these sub-contractors' plants. Designs of the product are being constantly changed to improving these products after actual combat adds to the complication of manufacture but nevertheless are desirable in the over-all accomplishment of program. Earnest people working on these programs are thoroughly fatigued and the question of personnel relationship and ability to get these things done enters into the problems as a whole.

But with all these headaches what progress has been made? The entire nation now is in production, but much planning and scheduling and organization and thinking before the job is put on the machine still has to be done. The average layman has no conception of the mass of details and the mass of work involved, and naturally becomes impatient. That same layman, however, will be equally amazed and startled when our whole production machine, geared up as it never has been geared up before to a single purpose of winning a war, is in full operation, and it is rapidly gaining momentum, hour by hour.

FREDERICK B. HEITKAMP, vice-president of American Type Founders Sales Corp., is known by printers, craftsmen and sales executives as a dynamic speaker and authority on sales technique and sales management.

Mr. Heitkamp joined American Type Founders in April, 1936, as chief executive in charge of the company's nation-wide sales organization. He had formerly been general sales manager of the Cincinnati Milling Machine Co. and Cincinnati Grinders, Inc., and vice-president of Lyon Metal Products, Inc., of Aurora, Ill., and is a graduate of Rutgers University, class of 1917. He is one of the charter members of the National Industrial Advertisers Association and is past president of the Direct Mail Advertising Association, and also a member of the American Marketing Society, the Sales Executives Club of New York and the New York Advertising Club.



BORN OF NECESSITY

NECESSITY, the age old Mother of Invention, is busier than ever these days. With many of our regular sources of material cut off she has to find new sources or devise methods for "getting around them". Until recently it has been almost universal practice among electrical instrument makers to use highly polished sapphire jewels for the bearings of indicating instruments. The present conflict, however, has cut off the source of supply of sapphires for this purpose and so it has been necessary to find a substitute material. The jewels of hot-formed, high-alumina-content glass shown in the photograph above is General Electric's solution to the problem. Based on a large amount of development work done in the G. E. laboratories about 25 yr. ago, a method has been developed to manufacture these glass jewels to carefully controlled dimensions and with characteristics that leave little to choose between the new jewels and the sapphires they replace. These jewels can now be produced in quantities sufficient to assure that the jewel bearings will not limit the quantity of instruments that can be produced

WITH THE EDITORS

◆**IS VICTORY SO CERTAIN?**... Whether Washington as a whole is ahead of, or behind, the rest of the country in gaging the capacity of the American people for a voluntary all out war effort is a matter of opinion. But it is a fact that during early summer the part of Washington which does the work and knows the facts was jittery with the realization: (1) that it is quite possible for us to lose the war; and (2) apparently, equally impossible to convey this to the public with factual data.

Back of it all is a belated but widespread realization that the war can be lost, but not won, from Washington, that it must be won by the people as a whole who supply the armed forces with both men and the implements of war. Individuals have recognized this from the first. So have some groups, but only of recent weeks has the recognition become sufficiently widespread to be encouraging to force action and carry the gravity of the situation to the general public.

◆**O.W.I.** . . . To carry this message to the people, the President set up Elmer Davis as head of the new Office of War Information, staffed by experienced newspaper and business paper men and incorporating the former Office of Facts and Figures. Upon Mr. Davis falls a responsibility equal to, perhaps exceeding, that of Mr. Nelson. One must plan the program, the other win popular support to carry it through. Mr. Nelson has the soft job.

What Mr. Davis can do, even with the wholehearted support of the President, remains to be seen, but he has already made a noble start. Releases made and widely quoted in the newspapers during August should do much to prevent complacency, bring home the realization that victory or defeat rests with the people, and kill all rumors of an early peace.

"War production fell below schedule in June on military planes, tanks, naval vessels and most types of artillery . . . We have paid for the perfect protection given to our troop convoys to Europe and the South Seas with heavy shipping losses off our own coasts . . . During the first half of the year sinking of merchant vessels far exceed new construction . . . We shall probably be well into 1943 before we have as much merchant shipping as we had on Dec. 7, 1941 . . .

". . . We have done pretty well, but not well enough . . . conversion from peace time to war time uses was a job that had to be learned . . . Mistakes made this time were perhaps unavoidable and will not be made again but their consequences will be with us for some time . . . Faulty control of inventories and flow of materials has necessitated some shutdowns . . . Time will never be on our side till we use it better than the enemy does . . . Meantime our allies have carried most of the load . . . done most of the fighting . . . we have not given them as much help as we led them to expect . . . We could lose this war . . . as a nation we are not yet more than ankle deep . . ."

◆**THE ENEMY.** . . . As a general policy only information which would give aid and comfort to the enemy will be withheld. But 'aid and comfort' is a broad and general term subject to individual interpretation which in the past has tended to include practically everything.

Some aid and comfort may of necessity have to be supplied the enemy to break the production and psychological bottleneck with a realistic rather than a 'better-safe-than-sorry' censorship policy. While administered by civilians with full appreciation of the need, censorship is dominated, as it should be, by the armed forces. These branches recognize the inherent risk involved in battle but are often reluctant to take the same risk in the Battle of Production. To give an ounce to gain a pound is good strategy in war or peace.

On the whole, however, censorship tends toward the liberal in that it remains open to argument. The only censorship that might possibly be classed as downright arbitrary and none too intelligent is that exercised by the Board of Economic Warfare over publications for export to foreign countries. 'Nothing that's new' seems to be the universal gage—a standard that no editor can accept with a clear conscience or advance as justification for continued existence.

◆**POLITICS AS USUAL**... Really disheartening is the 'politics-as-usual' bloc in and out of the capital—proponents and victims of pressure and special groups who place individual, industry, trade association or union advantage above national needs. Collectively they do lip service to the war effort, individually they work only for private gain.

Hoarding a heritage won by others, they refuse to rally to the common cause and prefer to interpret 'free enterprise' as a jackal role—freedom to live off the kill of others. Unconscious of the fact that if the war is lost they lose all, they are deeply conscious of their inability to win in normal times what they can force in an emergency. Apparently integrity is a luxury many Americans cannot yet afford.

Chief victims of these pressure groups are the members of Congress of which the former isolationist and the so-called farm bloc minorities have been the most prominent. True, the most potentially dangerous recent action—the rubber 'squeeze' from alcohol—was passed by approximately a tenth of the Senate and a third of the House. The rest were home mending political fences after lacking the moral courage to either adjourn or stay and fight it out. Even congressmen sometimes overlook the fact that in a crisis responsibility to the nation takes precedence over responsibility to themselves or to their constituents.

◆**OPTIMISTIC PESSIMISM** . . . Undue optimism regarding an early peace is decidedly out of place. "There is," said one prominent man in a strategic position, "no information in this office which gives the slightest support to the rumor that the war will end this year—if so it will end in defeat."

At the same time pessimism is equally out of place. Government departments and men not actively participating in the war effort have been pretty well sidetracked, to give the boys that do the work a clear track. Also there is a growing realization that Americans cannot point to the tremendous potential productive capacity and stop the war with a gesture. To win we must work and fight not with surplus resources and production but with vital necessities.

While many do not realize how hard we must work to win, 6 mo. have streamlined the war machine. The recent hue and cry about rubber, transport planes and shipyard steel was the swan song of the preparatory confusion. From now on 'essential civilian services' can be expected to shrink rapidly as war preparation gets under way in earnest.

Political sharpshooters, shedding crocodile tears (for the well meaning Kaisers' and Higgins') to further their own selfish ends may yet get Nelson's scalp—and Henderson's as well. Both men know their sole job is to supply the Army, Navy and related services with equipment up to the maximum allowed by our resources.

To say Army and Navy officials dominate the show is a self-evident truth. Their's is the responsibility for fighting the war and any other arrangement would soon degenerate into a political football. WPB's function is to produce and distribute equitably. It is the biggest job ever undertaken. It is being done and done well, not by supermen, but by human beings that you and I know. They are not infallible but they are the nation's best, capable and conscientious. Someday they will receive recognition for the job they have and are doing—they can never be repaid.

By B. O. BUCKLAND
Turbine Engineering Dept.
General Electric Company

Deposits in a turbine steam path can be detected by observation of performance, but it is desirable to have reference data, taken while the turbine is clean, in order to determine accurately whether deposits have accumulated. As the deposit builds up, an increase in shell pressures occurs. How to determine and interpret this pressure increase, and the inter-relation of the various factors involved, are explained in this article. Test data from three different turbines are also given to show the effect of the deposits on shell pressures and performance. In general the efficiency decreases about 1 per cent for each 1 per cent weighted average increase in shell pressure. For small steam flows the efficiency change will be somewhat more than this, for large steam flows less

Effect of Nozzle and Bucket Deposits on TURBINE SHELL PRESSURES, CAPACITY AND EFFICIENCY

ACCUMULATION of salt or silica deposits in a turbine has three effects which are measurable when the turbine is assembled and in operation: (1) Increase in shell pressures; (2) reduction in efficiency; and (3) reduction in capacity.*

Changes in these three characteristics can be detected by comparing the values obtained when the turbine is known to be clean, with those obtained at some later time when it is known or suspected that the turbine has accumulated deposits. It is desirable, therefore, to make careful measurements of flows, shell pressures, steam conditions, and load with a clean turbine in order to establish a set of reference data which can be used to determine whether or not changes occur, and if so, at what rate they take place with operating time.

Fig. 1. Silica type deposits on the eighth, ninth, tenth and eleventh stage buckets of a high pressure turbine in one of the newer eastern central stations

In cases where regular operation is not attained and turbine tests are not made immediately after starting a new turbine, the best time to make tests to establish bench marks of reference pressures and turbine performance will be immediately after the first overhaul of the turbine. The turbine will be clean when new and, while it is best to make the required measurements at that time, experience shows that very often considerable time elapses between the initial starting of a newly installed turbine and the establishment of regular operation.

During this time, numerous plant adjustments are made and details of the new construction completed, all of which prevent making the turbine tests immediately after the initial starting. The tests are made after the period of adjustment is over, when regular operation is attained and the plant operators are ready to plan and carry out the tests. Very often, however, the conditions obtained during the adjustment period are more conducive to the formation of deposits than at any other time, so, when the tests are made, some of the shell pressures are found to

*For practical methods of removing these deposits see How to Remove Turbine Deposits, by B. O. Buckland, POWER PLANT ENGINEERING, p. 78, April, 1942.

be higher than the turbine designer predicted. Subsequent turbine overhauls generally reveal that in such cases the turbine is found to contain deposits.

When the reference data have been established, a simple way to tell whether deposit is accumulating is to note changes that occur in shell pressure. Changes in shell pressure can result from damage to the turbine as well as from deposit, but changes due to the former cause can generally be recognized. Damage usually extends over fewer stages than does a deposit, and, in cases where it does not, the changes are apt to be so marked that the cause is obvious.

Correction of Shell Pressures and Flows

A means of correlating or plotting the flows and pressures measured during a test is necessary. When the tests are made it is usually not convenient, and sometimes not possible, to hold the initial steam conditions and exhaust pressure at the same values for all test points. Thus, the flows and the shell pressures measured must be corrected for variations introduced by differences from a constant or specified value, in initial steam temperature, pressure and in some cases exhaust pressure.

Shell Pressures Defined

The term 'shell pressure' is synonymous with the back pressure against which the stage works, and, in a group of stages the shell pressure of one stage is the bowl or initial pressure of the following stage. The shell pressure is dependent on the flow past the stage, the steam flow areas of the nozzles and buckets of the succeeding stage, the specific volume or temperature of the steam in the stage, and, the shell pressure of the succeeding stage. The relationship may be expressed as:

$$Q = \sqrt{\frac{p_n}{v_n}}\, A_{n+1}\, B f\left(\frac{p_{n+1}}{p_n}\right) \quad \text{..Eq. 1}$$

where

Q = Flow past the stage in lb. per hr.

p_n = Shell pressure in the nth stage in psi abs.

v_n = Shell specific volume in the nth stage in cu. ft. per lb.

A_{n+1} = Effective flow area of the $(n+1)$th stage in sq. in.

Fig. 2. Silica type deposits on the second stage low pressure diaphragm of a turbine in service on the eastern seaboard

B = Steam flow which will pass adiabatically through a perfect nozzle of 1 sq. in. area with sound velocity pressure drop, or more, across the nozzle in lb. per sq. in. per hr. per unit of $\sqrt{p_n/v_n}$.

p_{n+1} = shell pressure in the $(n+1)$th stage in psi abs.

$f\ (p_{n+1}/p_n)$ = a function of pressure ratio which for superheated steam has the value shown in Fig. 3.

B is a function of the enthalpy and pressure of the steam, but the rate of variation is so small that for our purposes B can be considered constant. A_{n+1} is a function of the nozzle and bucket areas, the energy on the stage, and the wheel speed. Its rate of variation with energy is so small that for a particular turbine where the speed and areas are fixed A_{n+1} can also be considered constant. Likewise, if in a group of stages the pressure ratios on all the stages remain constant, the term p_{n+1}/p_n remains constant and the flow is proportional to $\sqrt{p_n/v_n}$ in the stage. Also, in the

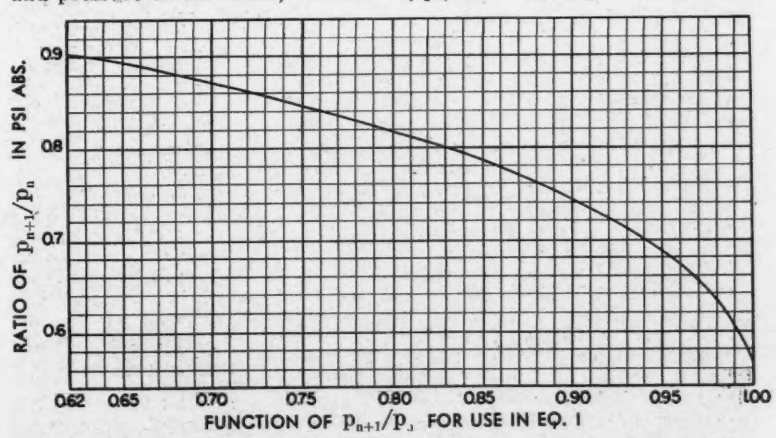


Fig. 3. Percentage of unrestricted flow for a given pressure ratio. For superheated steam, the coefficient on the vertical scale is used to calculate the steam flow past a given stage by means of Eq. 1

superheated region, and if the pressure ratios remain fixed, $\sqrt{p_n/v_n}$ is proportional to $\sqrt{p_o/v_o}$

where p_o = throttle pressure psi abs.

v_o = throttle specific volume in cu. ft. per lb.

so that $Q = \text{constant} \times \sqrt{p_o/v_o}$.

Therefore, if a series of tests are made in which the throttle pressures and temperatures maintained in each test are a little different from each other, and from a specified value, the test values of flow and pressure can be corrected as follows: Multiply all the flows past the stages by the ratio of

$$\left(\sqrt{\frac{p_o}{v_o}}\right)_{\text{Specified}} \text{ to } \left(\sqrt{\frac{p_o}{v_o}}\right)_{\text{Test}}$$

and all the shell pressures by

$$\left(\frac{p_o \text{ Specified}}{p_o \text{ Test}}\right)$$

, and plot the resulting shell pressures against their respective flows.

This rule for correcting the test flows and pressures is applicable to those stages which are in the superheated region and across which the pressure ratio is constant as the throttle steam conditions are changed. In a condensing turbine the stages in the superheated region will maintain constant pressure ratios with variation of either throttle pressure or throttle temperature.

All the stages in the moisture region except the last few will maintain constant pressure ratio with variation of throttle pressure but not with variation in throttle temperature. This statement can be explained by the following considerations.

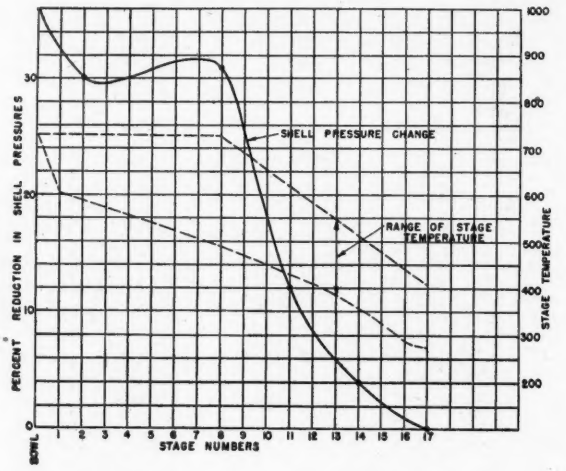


Fig. 5. Reduction in shell pressure due to the removal of blade deposit from a high pressure turbine. Test made with 665 psi abs., 730 deg. F. steam at the turbine throttle

For variations of throttle pressure with a fixed exhaust pressure, the pressure ratios of some of the stages, of course, must change. The energy on the later stages of a condensing turbine, however, is sufficiently large that the change is confined to the last stage or in cases of light loads on the turbine to the last few stages. The changes in the pressure ratios of the last few stages which occur with fixed exhaust pressure and variable throttle pressure are equivalent to those which occur at a fixed flow and throttle pressure and a variable exhaust pressure.

When the energy drop across the last stage is high, as it is with high turbine flows and loads, variations in exhaust pressure are not felt in the turbine even at the bowl of the last stage. When the turbine flows and loads are low and the pressure drop and energy across the last stage are small, then changes in exhaust pressure may be felt as far back as two or three stages from the exhaust.

Variations of throttle temperature with fixed throttle pressure result in a change in pressure ratio in some of the stages, due to the change that occurs in the pressure-temperature-volume relationship of the steam in going from the superheat to the wet region. For variation of throttle temperature in the superheat region the value of $\sqrt{p_n/v_n}$ in the superheat stages changes in proportion to the corresponding value at the throttle.

However, the values of $\sqrt{p_n/v_n}$ in the wet stages vary only about a third as much as the value of $\sqrt{p_o/v_o}$ at the throttle. The result is that as the throttle temperature is changed, the flow through the stages is changed in proportion to the change in $\sqrt{p_o/v_o}$ at the throttle, but, since the $\sqrt{p_n/v_n}$ in the wet stages does not change a proportional amount, the pressures in the wet stages change relative to those in the dry stages. With increasing throttle temperature the wet stages drop in pressure relative to the dry stages and vice versa.

This phenomenon can be compensated in making the pressure and flow corrections to the test data by increasing or decreasing the test pressures measured in the wet stages at the rate of 3½ per cent for each 100 deg. F. deviation of the test throttle temperature from the specified value. If the test temperature is high the wet stage pressures are increased, and if the temperature is low the

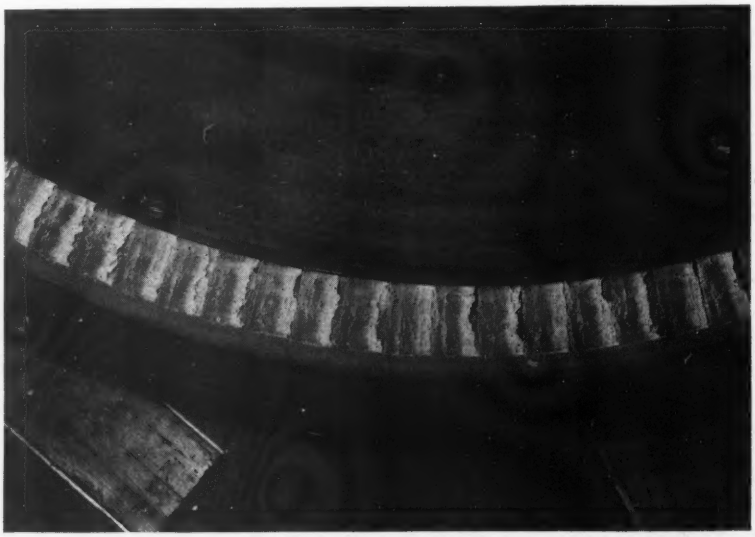


Fig. 4. Silica type deposits on the ninth stage nozzles of the turbine shown in Fig. 1

pressures are decreased. This correction, applied to the wet stage pressures, is made in addition to the corrections previously given.

Non-Condensing Turbines

In the case of non-condensing turbines, in which the energy drop across the turbine is relatively small, variations in exhaust pressure will affect the shell pressures measured. Since these turbines usually have superheated exhaust steam and the exhaust steam conditions can readily be measured, this additional variable as well as the complete correction of the flows and pressures can be easily taken care of as follows:

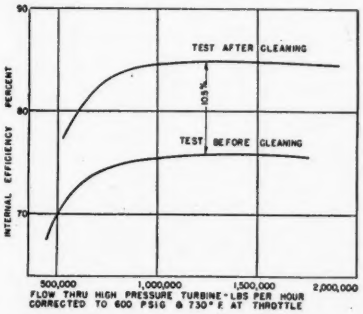


Fig. 6. Improvement in efficiency of the turbine (shell pressure curves shown by Fig. 5) after cleaning

From the test readings for each shell pressure either the ratio of test exhaust pressure to the shell pressure measured or the inverse of this ratio is plotted against the ratio of the test flow to $\sqrt{p_e/v_e}$

Where p_e = test exhaust pressure in psi abs.

v_e = test exhaust specific volume in cu. ft. per lb.

The ratios of the shell pressures to the exhaust pressure might be plotted against the ratio of the test flow to the product of $\sqrt{p_e/v_e}$ and B, where B is defined as before. This function would then represent the area which would pass the test flow with sound velocity pressure drop at the test exhaust conditions. However, B varies so slowly with test conditions that no appreciable error is introduced in a particular test by not using it.

That this method of plotting the test results should correlate them can be seen by considering the factors which govern the flow past any stage and their relation to the exhaust conditions and the pressure ratio from the stage to the exhaust. The factors are given in Eq. 1. For a constant turbine speed the following relation can be shown to be true:

$$\sqrt{\frac{p_e}{v_e}} = \sqrt{\frac{p_n}{v_n}} \times f\left(\frac{p_e}{p_n}, T_n\right) \quad \text{.....Eq. 2}$$

Where T_n is the absolute temperature in the nth stage. However, the effect of the temperature is very minor, and for reasonably large temperature variations

$$\sqrt{\frac{p_e}{v_e}} = \sqrt{\frac{p_n}{v_n}} : f\left(\frac{p_e}{p_n}\right) \quad \text{....Eq. 3}$$

Similarly the effective flow area A_{n+1} and the stage pressure ratio p_{n+1}/p_n are dependent only on the ratio p_e/p_n, and Eq. 1 reduces to

$$\frac{Q}{B\sqrt{p_e/v_e}} = f\left(\frac{p_e}{p_n}\right) \quad \text{....Eq. 4}$$

Thus a plot of one of these functions against the other should, and does, correlate the test results.

When the reference tests and any subsequent tests are corrected to the same specified steam conditions, any change shown in shell pressures will indicate a change in the turbine. Increased pressures in the first and early stages usually indicate a soluble deposit. If the increase occurs in only the middle stages of a condensing turbine, or, in the middle and later stages only of a non-condensing turbine, an insoluble deposit is indicated.

Effect of Deposit on Capacity, Efficiency and Shell Pressure

It would be convenient if the reduction in efficiency due to deposit could be related to either the reduction in capacity or the increase in shell pressure, or both.

Reduction in capacity is the result of the combination of reduced flow and reduced efficiency. The extent of the flow reduction is dependent on the amount of the deposit and its location. The greater the amount of deposit the greater the flow reduction, of course, but deposit in the first or early stages has a great deal more effect on the flow than deposit in the later stages. The flow reduction caused by deposit in the first and early stages will be approximately proportional to the reduction in the nozzle areas, but flow reduction due to deposit in the later stages will not be so great.

In this case, the energy on the later stages is increased and that on the early stages is decreased. The amount of the flow reduction therefore will be equivalent to that which would result from an increase in back pressure on the early stages of an amount equal to the increase in shell pressure. The amount, therefore, will depend on the normal energy per stage in the early stages. Lightly loaded stages will feel a greater effect than stages with a high energy loading.

Reduction in efficiency is due to the roughening of the passage surfaces and their change in form, as well as to the change in energy distribution through the turbine and to any increase in leaving loss resulting from deposit in the last stage buckets. The rough surfaces and distortion of passage form reduce the jet velocities obtained, the disturbed energy distribution reduces efficiency by increasing the relative wheel speed in some stages and reducing it in others, and any reductions in the last bucket area increases the velocity and the energy in the steam leaving the turbine. The loss due to poorer nozzle action can be assumed to be approximately proportional to

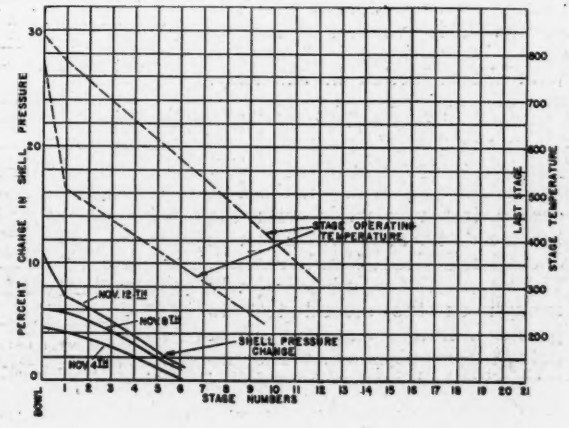


Fig. 7. Difference in shell pressures before and after washing a turbine in which deposits formed very rapidly

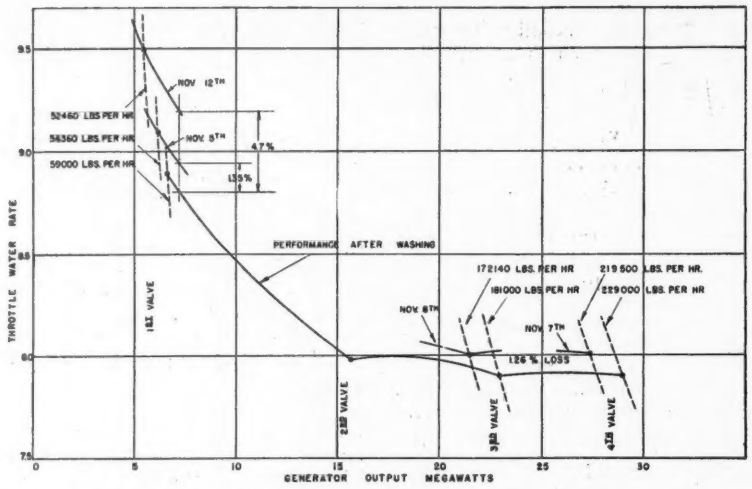


Fig. 8. Change in water rate due to blade deposits showing the effect of washing. The shell pressure changes and stage temperatures of this turbine are shown by Fig. 7

the product of the percentage reduction in area and the energy drop over the region of the deposit.

Change in shell pressure gives a measure of the amount of the deposit, but the amount indicated by a particular shell pressure change is dependent on the location in the turbine of the point of pressure change. When the deposit extends uniformly to the exhaust for example, since the exhaust pressure is fixed, the later stages will not show the same increase in pressure that the earlier stages will.

Changes in the effective passage areas as well as the effect of the changes in energy distribution and leaving loss can be computed in any particular case, but the computations are involved and tedious. To obtain a simple and convenient, though not very precise, relation between the change in efficiency and change in shell pressure, the per cent increase in shell pressure is averaged by weighting it with the energy on the stage in which it occurs. This averaged shell pressure change is then compared with the reduction in efficiency.

Three Examples

In the following three examples this comparison is made with the results as shown. In the first case a test was made with the turbine dirty, after which it was opened and cleaned and retested. The deposits accumulated slowly enough on the second test to permit a fairly consistent set of data to be obtained. The increase in shell pressures produced by the deposit is shown in Fig. 5 and the change in efficiency in Fig. 6. The change in efficiency in Fig. 6 is about 0.6 per cent in efficiency for each 1 per cent change in weighted average shell pressure.

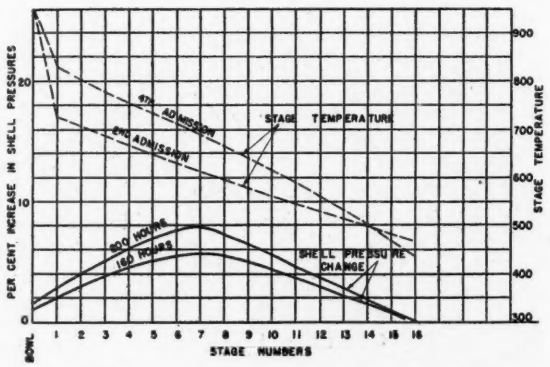


Fig. 9. Change in shell pressure (compared to values obtained by test 24 hr. after the turbine was first started) for 160 and 200 hr. of operation due to blade deposits. Throttle conditions for this turbine were 2015 psi. abs., 950 deg. F.

In the second case in which the turbine was assembled clean, the deposits accumulated to such an extent during the period of test that the first-stage shell pressure was increased 7 per cent and the efficiency was reduced 1¼ per cent at high loads and 4.7 per cent at low loads. The turbine was then washed and several consistent tests were obtained quickly and immediately after washing. The shell pressures and water rates before and after washing are shown in Figs. 7 and 8. On the foregoing basis of weighting the per cent increase in shell pressure, the change in water rates in Fig. 8 varies from 0.6 per cent at high loads to 0.9 per cent at low loads for 1 per cent average change in shell pressures.

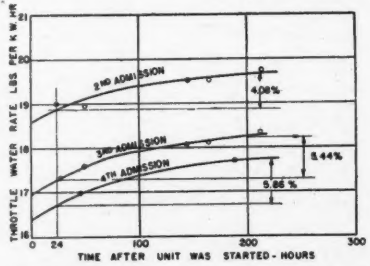
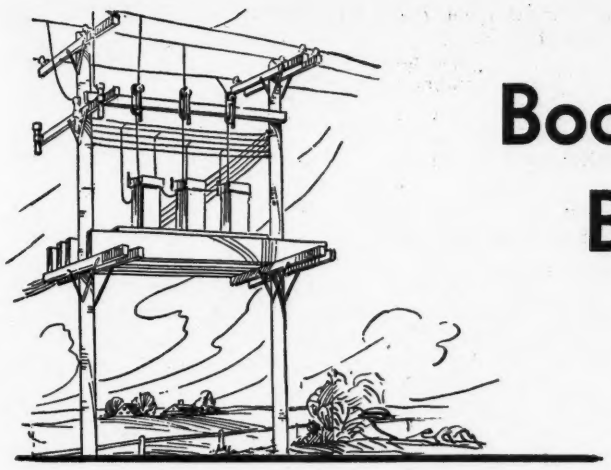


Fig. 10. Increase in water rate with time. This data is for the turbine represented by Fig. 9

Figures 9 and 10 show changes in shell pressure and water rate due to deposit in the third case in which the turbine was assembled clean and tested. The change in shell pressures which occurred between the first test point, within 24 hr. after starting, and those obtained 160 hr. and 200 hr. after starting is shown in Fig. 9 and the change in water rate in Fig. 10. The decrease in efficiency found in this case varies from 1.22 per cent to 1.80 per cent for 1 per cent weighted average change in shell pressure. The over-all average is 1.5 per cent loss in efficiency.

In two other cases in which similar information is available, and in which the change in efficiency was about 2 per cent, the change in efficiency per weighted average per cent change in shell pressure was about 1 per cent.

Thus the data here given relate the increase in shell pressure to the decrease in efficiency approximately as follows: The efficiency decreases about 1 per cent for each weighted average 1 per cent increase in shell pressure. For cases where the turbine is designed to handle small volume flow and the deposit extends to the exhaust, the decrease in efficiency will be closer to 1½ per cent, and for cases where the turbine is designed to handle large volume flow and the amount of the deposit is very great, the figure will be closer to ½ per cent.



Boosting and Bucking Transformers

BY VICTOR N. FRIEDMAN

IN ORDER to maintain a certain voltage at a given point on a distribution system various methods are available. These methods include manual and automatic regulation, the use of transformer taps, location of substations, spacing and size of conductors and the use of condensers or reactors. Cases frequently arise in which none of these corrective means are applicable due to the cost, location or the nature and size of the load. For example, assume a 2300 v., 3-phase distribution line at the end of which an additional load is to be connected. The size of the additional load does not warrant an outlay for regulators or additional copper. Also the load may be temporary. The additional load, of course, lowers the voltage on the entire feeder, but the voltage at the extreme end would be the lowest. That voltage may be so low as to be injurious to the connected motors. The torque of an alternating current induction motor varies as the square of the applied voltage and a fully loaded motor may overheat due to low voltage and high current. A means of overcoming such a difficulty is the use of booster transformers. Also, in some cases, the line voltage is too high for the particular load. In such a case a bucking transformer may be installed to decrease the voltage.

The boosting transformer is the same as the bucking transformer except that connections are reversed. In the case of the boosting transformer the secondary winding is connected so that the induced voltage in that winding is added to the line voltage while in the case of the bucking transformer the secondary voltage is opposed to the line voltage.

It should not be inferred that a motor must operate on the exact voltage rating. In reality motor manufacturers guarantee their motors at plus or minus 10 per cent of rated voltage, at rated frequency.

However, there are devices, other than motors, that do require voltage close to their rating.

Using a standard distribution transformer with a single primary winding and two secondary windings, there are four possible voltage boosts and four voltage bucks. Thus if a transformer is rated 2300 to 115-300 v. and is connected with the secondary coils in parallel and the primary connected to the supply side of the line, a boost or buck of 5 per cent is obtained. If the primary connections are changed so that the primary is energized from the raised side of the booster, a boost of about 5.2 per cent is obtained or a buck of about 4.75 per cent. Then again with the secondary coils of the transformer connected in series approximately 10 per cent boosts or bucks are obtained with the primary energized from the supply line or about a 11 per cent boost or a 9 per cent buck when the primary winding is connected on the raised side of the transformer. Figures 1 to 8, inclusive, show the connections and the accompanying tabulation shows the resultant voltages. In all cases the impressed voltage is taken as 2200 in case of boosts and 2500 in the case of bucks. Also a standard transformer of 10:1 or 20:1 ratios is considered.

It will be noted from the table that the boosts or bucks are not exactly double for the 10:1 ratio that they are for the 20:1 ratio with the transformer primary connected on the load side of the secondary winding. This is because the voltage induced in the secondaries of the transformers in Figs. 3, 4, 7 and 8 are not 5 per cent or 10 per cent of the supply voltages but more or less depending on whether the connection is for a boost or buck.

The resultant voltages are direct additions or subtractions of the impressed voltages and the secondary voltages when connections are made on the line side of the transformer. This applies to Figs. 1, 2, 5 and 6. When the primary connections are made on the load side of the transformer for boosting as in Figs. 3 and 4 the following formula may be used:

$$E_{load} = \frac{E_{line} \times \text{Transformer Ratio}}{\text{Transformer Ratio} - 1}$$

In the case of bucking when the primary is connected to the load side of the transformer, the formula is

$$E_{load} = \frac{E_{line} \times \text{Transformer Ratio}}{\text{Transformer Ratio} + 1}$$

In 2-phase systems the voltage may be increased or reduced as in single-phase systems by using one transformer in each of the two phases.

If a case arises in a 2-phase system in which one phase voltage is 5 per cent or 10 per cent higher,

or lower, than the other phase and it is desired to equalize them, one transformer may be installed to boost or buck in one phase only.

In 3-phase systems the voltages may also be varied up or down by the same method. In the case of a 3-phase, 4-wire system the individual phases may be varied by using boosting or bucking transformers with their primaries connected to the neutral or fourth wire in each case. One, two or three phases may thus have their voltages increased or decreased.

In the case of a 3-wire system 2 or 3 phases may be changed in voltage but not one. That is, the installation of one transformer affects the voltage between 3 of the 3 voltage readings.

Thus in Fig. 9 assume a 10 per cent boosting transformer is installed in "A" phase only with its primary connected as shown across "A" and "B" phases. Then referring to Fig. 10 the voltage A'B will be AB + A'A or 2200 + 220 or 2420 which is a 10 per cent boost. The voltage BC does not change. The voltage CA' is then

$$\sqrt{CA^2 + AA'^2 - (2 \times CA \times AA' \times \text{Cos Angle } CAA')}$$

from the law of cosines. As angle CAA' is 120 deg.

$$CA' = \sqrt{2200^2 + 220^2 - [2 \times 2200 \times 220 \times (-.5)]}$$

or 2318 v. or 5.4 per cent boost.

By the same process the bucking effect may be calculated by using CA" in Fig. 10. The voltage A"B is then 2200 — 220 or 1980 v. or a 10 per cent buck. The voltage BC is unchanged and CA" is

$$\sqrt{CA^2 + AA''^2 - (2 \times CA \times AA'' \times \text{Cos } CAA'')}$$

in which Angle CAA" is 60 deg.

$$\text{Then } CA'' = \sqrt{2200^2 + 220^2 - (2 \times 2200 \times 220 \times .5)}$$

or 2098 v. or a 4.6 per cent buck.

If 10 per cent boosting transformers are installed in two phases the resulting boosted voltages, Fig. 11, CA' is 2318 v. or a 5.4 per cent boost as previously shown and voltage A'B' equals

$$\sqrt{A'B^2 + BB'^2 - (2 \times A'B \times BB' \times \text{Cos } A'BB')}$$

in which Angle A'BB' is 120 degrees, or A'B' =

$$\sqrt{2420^2 + 220^2 - (2 \times 2420 \times 220 \times (-.5)}$$

or 2537 v. which is a 15.3 per cent boost.

Voltage B'C is 2200 + 220 or 2420, a 10 per cent boost. In Fig. 12 is shown the vector diagram of a 10 per cent buck in 2 phases. The resultant voltages are:

CA' = 2098 v. or a 4.6 per cent buck.

A'B = 1879 v. or a 14.6 per cent buck.

B'C = 1980 v. or a 10 per cent buck.

The effect of a 10 per cent boost in all three phases is shown in Fig. 13.

The three voltages A'B', B'C' and C'A' are all equal to 2537 v. or a boost of 15.3 per cent.

Finally we come to three bucking transformers with voltages as shown in Fig. 14. All three voltages, A'B', B'C' and C'A' all are equal to 1879 v. or a 14.6 per cent buck.

By connecting the primaries of the 3 transformers in Fig. 9 on the boosted or lowered sides of the transformers a slightly increased or decreased voltage may be obtained as previously noted under the discussion of single-phase connections.

In using transformers for boosting or bucking certain precautions are necessary. The secondary of a transformer used for boosting or bucking is directly connected to the primary circuit, hence the voltage of the secondary winding to ground is greatly increased. The transformer case should be well insulated from the

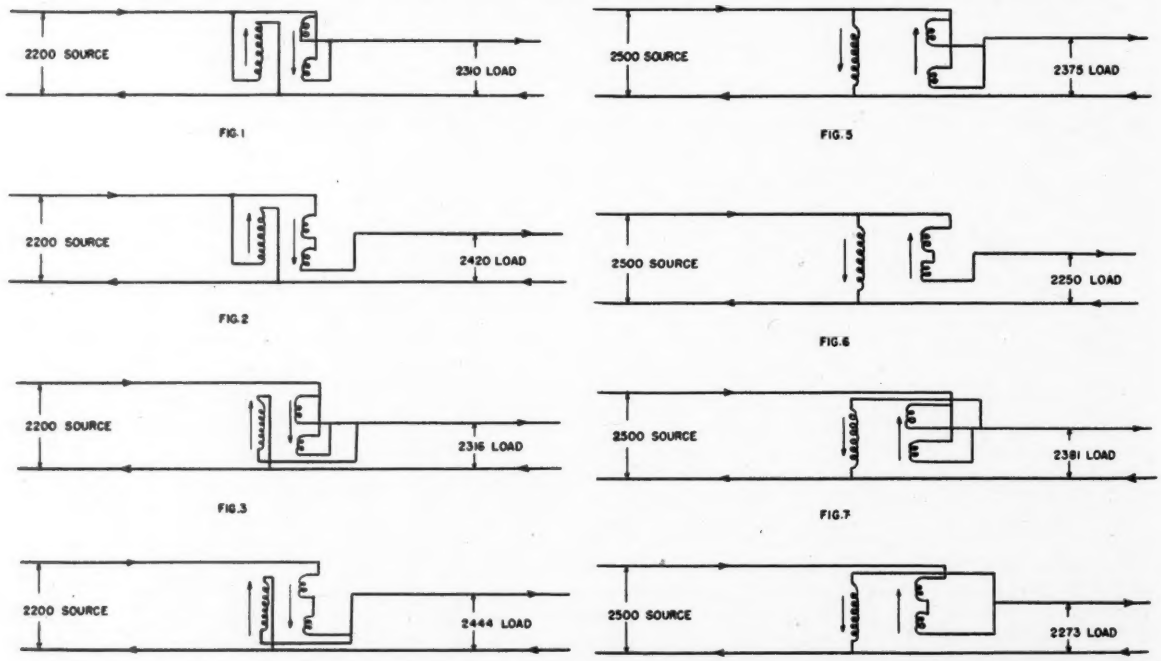


Fig. 1 to 8. Various connections of a standard distribution transformer with a single primary and two secondary windings. The resultant voltages from these connections are shown in the accompanying tabulation

Resultant Voltages of Connections Fig. 1-8

Fig.	Impressed Voltage	Transformer Ratio	Resultant Voltage	Per cent Boost	Per cent Buck
1	2200	20:1	2310	5	—
2	2200	10:1	2420	10	—
3	2200	20:1	2316	5.2	—
4	2200	10:1	2444	11.1	—
5	2500	20:1	2375	—	5
6	2500	10:1	2250	—	10
7	2500	20:1	2381	—	4.75
8	2500	10:1	2273	—	9.1

ground and in case of pole mounting care should be used that a lineman going up the pole does not handle the transformer case as he would that of a transformer used for ordinary service.

A transformer used for boosting or bucking purposes is similar to a current transformer in that one winding is in series with the load and if the other winding is open-circuited the counter e.m.f. of the opened coil is removed and the magnetic flux in the core of the transformer rises to a high value thus increasing the induced voltage in the open-circuited coil. This induced voltage may be several times the normal rated voltage and damage to the primary winding will probably result. For that purpose a transformer used for boosting or bucking purposes should not be fused. If a fuse is installed in the primary coil circuit of the transformer and that fuse blows the high voltage induced in the primary coil will cause an arc across the fuse and probably break down the primary winding insulation.

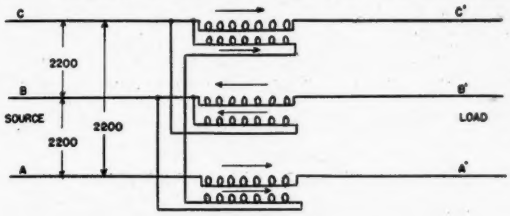


FIG. 9.

Fig. 9. Transformers connected in a three phase circuit

Furthermore, no secondary lighting or power load should be directly connected to the secondary of such a transformer as the secondary is connected to the primary and the potential to ground is greatly increased.

Precautions should also be used in cutting in or out a boosting or bucking transformer. The safest way is to open the circuit with a suitable device ahead of the transformer. One method used in cutting such a transformer in or out is the use of a series cutout which simultaneously opens the primary transformer circuit and short-circuits the secondary winding or the reverse. Another method consists in the use of a reactor connected across the transformer secondary while the primary circuit is opened, or closed.

The size of a transformer to be used for boosting or bucking is determined by the load served by the transformer and the percentage of voltage boost or buck. The current in the secondary of the transformer (the load current), multiplied by the volts boost or buck and divided by 1000 gives the k-va. required.

Thought should also be given to the location of the boosting or bucking transformer. Thus if all the load is concentrated at the end of the line the boosting or bucking transformers may be installed at any point between the start and end of the line and at times of light load the voltage at the end of the line will be high. Of course, installing the transformers at the start of the line will decrease the line drop during the time the load is on. If the load is distributed over the line it may be better to install the transformers at some particular point, not the end of the line, so that excessively high voltage is not impressed on a given load.

Figs. 10 to 14. Vectors for various 3-phase connections

FUEL WASTE ESTIMATED AT 25 PER CENT

WITH a prospective fuel oil shortage in the Eastern States and the Pacific Northwest during the coming heating season and the prospect of less fuel of other types being available, it is essential to save the fuel that is now being wasted through overheating and improper use, which is estimated at 25 per cent, according to E. O. Eastwood, Seattle, president of the American Society of Heating and Ventilating Engineers and Professor of Mechanical Engineering, University of Washington.

Heating Plants Neglected

Failure to conserve our natural resources and to prevent the waste of labor and transportation facilities is inexcusable today. Too few owners and operators of domestic heating plants have a real conception of what happens to the fuel that they buy and burn. Heating plants are often neglected and are seldom inspected prior to the heating season. A survey of 42,000 house heating plants during the past 16 months indicated that less than 10 per cent were in satisfactory operating condition. Home owners should have their plants checked, inspected, cleaned and repaired during the next 60 days if they are to avoid distress and suffering next winter, said Professor Eastwood, and coal bins and oil tanks should be filled immediately so as to relieve the future strain on transportation facilities in the areas where fuel rationing may be considered necessary.

In New York City some of the large buildings have changed from oil to district steam from the mains of New York Steam Corp., with an estimated saving in oil of 383,000 bbl. annually. These include London Terrace, Paramount Building, Chesebrough Building, Chase National Buildings, Hotel Taft and Hotel Great Northern. Many such as New York Life Building have already returned to coal.

Through Professor B. M. Woods, Chairman of its War Service Committee, the Society has presented its findings and recommendations requested by the Federal Coal and Petroleum Coordinator and has advised the immediate active cooperation of all agencies within the government which have any authority over fuel, its production, distribution, delivery and price.

What the OPERATOR Wants to Know

Part I. Among other things the operator, whether in a central station or industrial plant, wants to know: What was built into the equipment; its characteristics and how and why it operates; how disturbances in one part affect other parts; whether trouble, when and if it develops, is local or more or less general throughout the country; and to what extent good operating practice can reasonably be expected to prevent outages and to what extent unscheduled outages may be expected as a price paid for bigger and better boilers. Each advance in practice brings new problems and while many of them have been solved, many are as yet unsolved. The author frankly reviews both groups under seven general headings: feedwater; pulverizers and burners; slag; baffles; spare parts; air leakage; and control. Feedwater and its treatment, probably the most important problem of all at present, and pulverizers are covered in Part I. Part II will cover the sections from ash and slag through air leakage. Part III is a "look at the record"—the operating charts from a number of boilers made by three manufacturers

by **Alfred Iddles,** *Application Engineer, The Babcock & Wilcox Co., New York, N. Y.*

A DESIGN on paper is of little value if it cannot be translated into an operating plant to successfully perform its intended function. In other parts of the world there is a sharp division line between the designer, who may be a doctor of engineering, and the operating organization which may be composed of mechanics.

In the United States, in the power plant or in the automobile factory or in the steel mill, the designer and the operator have the habit of much closer cooperation. The designer in overalls looking over the equipment in operation is a familiar sight and the author believes this is in large measure the cause of the rapid development of steam engineering. To further this viewpoint, he believes it pertinent at this time to review recent steam generating unit and power plant practice.

Even though the designer is familiar with operating problems and limitations, and designs and calculates performance in line with what has been or is known to be possible of accomplishment, it is still vital that the operator understand the intentions of the designer and expend sufficient effort to provide the technical supervision and organization qualities, which will obtain from the equipment, that for which it is intended.

The situation is somewhat analogous to the problem involved in design and operation of automatic electrical substations or in the complicated arrangement of special tools in automobile factories. The more complicated and efficient the apparatus, the more it is necessary to employ higher grade mechanics and maintenance men, even special tool room engineers and tool maintenance groups, to maintain the apparatus at its maximum efficiency. A modern power plant requires much more of chemical and metallurgical knowledge than once was the case with low pressure and low temperature. The need for men to supervise and maintain control equipment—the results man—is of growing importance.

However good the design of a steam generating unit or of a power plant, the plant needs an operator to make it work when it is moved from the blueprints to a plot of ground, and the better the operator, the better the results. It is not at all uncommon to have an investment of one, five, ten, or perhaps thirty million dollars in a power plant. The fuel consumption is likely to be a pound of coal, or equivalent in oil, for every kilowatt turned out. This is a real sizable chemical plant which needs expert operation if the owner is to get the most on his investment.

This discussion will not deal exclusively with central station units, however, for the number of high-pressure and high-temperature boilers now being placed in service in industries is far greater than only a few years ago. In fact there are many 600 to 800-lb. pressure industrial plants with steam temperatures between 800 and 850 deg. F. Efficiency of

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This material was presented by the author extemporaneously before the Metropolitan Section of the A.S.M.E. and the informal style of the oral presentation has been retained in adapting it for publication. It is an unusually comprehensive view of the good and the bad of present conditions by a man with first hand overall knowledge of both the operator's and designer's side. A native of Michigan, he started in as an operator in 1912, took time out for World War I, served as fuel engineer with the Bureau of Mines and has been active in construction, design and operation in the utility field since 1920. For several years he was chairman of the Prime Movers Committee of the N.E.L.A. (now the E.E.I.) and has been with the Babcock & Wilcox Co. since 1937

most of these industrial units is in the order of 85 per cent and thus there is involved the proper operation of high class fuel burning equipment and of economizers and air heaters.

Many of these industrial plants are operating with treated raw water make-up in varying degrees, so that the problem of feedwater control is very important. Incidentally, it is the one feature most often forgotten by the industrial plant management, both in providing for the desirable treatment in the design and in providing for competent personnel to handle it.

From the standpoint of operation there are seven fundamental problems.

The important items may be classified as follows: (1) feedwater and its treatment; (2) pulverizers and burners; (3) slag and ash deposits; (4) baffles; (5) spare parts; (6) air leakage; and (7) steam temperature and combustion control.

Rather than present arguments and arrive at conclusions that would quite probably be debatable under the widely varying circumstances that exist in the experience of each individual, we will present a look at the record and give certain examples to illustrate the problems, and throughout endeavor to point out the limitations that exist and the need for expert supervision of operation if the best is to be obtained from presently available equipment.

There is no intention to ignore the responsibility of the designer and place the blame for our difficulties upon the operator. Utilization of fuel and production of steam are still surrounded by many factors not completely understood. We are always searching for better material and both the operator and the designer are many times compelled to recognize the limitations imposed by economic situations, making their job more difficult.

Feedwater

This is perhaps the oldest question before the boiler operator. From the lime in the teakettle to the silica in high-pressure boiler tubes, it is always with us. Every advance in pressure has resulted in adding to the problem and chemists in operating plants are constantly on the alert to ease their troubles. Consulting chemists have worked hard to help solve these problems and the industry through its technical societies has assisted the interested parties in accomplishing a great deal in a relatively short time. Each time we think we have caught up with the situation, some new trouble develops.

Higher pressures appear to change the chemistry. There is a growing demand for more efficient use of material, which means higher heat inputs. In spite of the hard work expended to date and the very large improvement even the last 5 yr., there is still ample evidence that dangerous conditions persist. No operator of a high-pressure plant can afford to be complacent.

Oxygen will still corrode boiler parts—CO_2 and ammonia are suspected of being active agents. Efficient deaerating equipment is available so that there is little excuse for putting oxygen in a boiler, nevertheless at certain times during changes in operating cycles many a plant does put oxygen in the boiler and the result is damage. Everyone should check for oxygen content, periodically by the best test methods available, and, during load swings it should be done every few minutes in order to be sure that no set of conditions can exist which leaves oxygen in the feed without its presence being recognized.

It is a matter of opinion whether silica or sludge is the next most troublesome problem, but silica has a habit of forming a very tenacious scale on tubes in some boilers and of showing up in carryover by deposit on turbine blades. There is a marked difference in silica content of natural water and apparently some silica contamination in chemicals used for internal treatment. It is difficult to remove this silica by treatment of raw water and seldom does an evaporator produce condensate entirely free from some carryover.

Some plants find it necessary to limit the silica concentration in the boiler water. As far as I know, however, there is no reliable guide as to what is permissible. Sometimes a concentration of 5 to 10 seems to cause trouble and other jobs with 200 do not. I know of two instances where the rate of heat input is almost identical. One has silica trouble and the other does not.

Where considerable amounts of make-up are used, the carbonaceous zeolite softener is advantageous, for it eliminates silica contamination existing in the older type. Some chemists believe that the CO_2 content of steam has an effect upon the form which the silica in the carryover will take on turbine blades. If this is a factor, then sufficient experiments should be run to determine the facts.

In general, the other common varieties of scale can be prevented. There is little excuse for sulphate or carbonate scales unless large quantities of raw water are used and this water has rapid changes in its scale-forming content. This sometimes occurs in plants using water from rivers that are affected by flood stage or from lakes affected by direction of wind or by waves.

A number of plants are in trouble from carryover from evaporators. It is not safe to assume that the only raw water put into a boiler comes from condenser leakage. It has often proved desirable to use steam separating devices in evaporators to decrease the carryover. In many cases it is desirable to run a continuous check on concentration of condensate to be sure

Fig. 1. Typical corrosion pits which occur erratically and which as yet are not fully accounted for. These pits are found in tube ends, in the lower ends of dry ash hoppers, where gas temperatures are down to 1500 deg. F. and in vertical tubes where the flow is high

of no contamination from the evaporators.

Where large quantities of raw water make-up are required, the usual treatment for scale prevention is external to the boiler. This may be lime soda, hot or cold, with special additional treatment for precipitation of silica, or some variation of this basic treatment. Even with the best of raw water treatment, a small amount of scale-forming material is put into the boiler so that both for a boiler with raw water and one with evaporator make-up, it is necessary to add some treatment within the boiler.

In general, scale formation can be prevented by treatment with phosphate with or without other chemicals to adjust for boiler water condition. This treatment is likely to produce a sludge which may be troublesome. Either the quantity of this sludge must be kept at a low level or its physical condition must be controlled so that it will not stop in undesirable locations or bake out in tubes and form a semi-scale.

There are many 600, several 800, and at least one 2000-lb. boiler operating with treated raw water as the principal supply. Very great care is necessary to maintain accurate treatment or scale-forming material will get into the boiler and do its damage. Continuous blowdown is of course necessary to maintain the boiler water concentration within acceptable limits. Some operators meter this blowdown.

At least one operator runs a continuous check, consisting of a balance between input and output to the boiler. He calculates all chemicals introduced and balances these against chemicals removed either by blowdown or in steam and he has been able to operate two 900-lb. boilers for almost 5 yr. without ever having scale formation or an outage due to tube trouble.

Large quantities of sludge are troublesome by adhering to tubes at their entrance from headers or drums and by piling up in the headers to interfere with circulation. Deposition of this sludge at troublesome points can in some degree be prevented by suitable design. Dead points in the circulation can be eliminated and appropriate blowdown, either intermittent or continuous, can be provided for partial removal of sludge. However, some treatments produce a sludge which will accumulate in tubes that have rapid circulation and either stop the water flow by constriction or be baked on in semi-scale form. This will result in decreased heat transfer and tube failures.

Circulation Is Not Always to Blame

It is common practice for some chemists to immediately question the circulation when a tube failure is discovered. They say that there is inadequate water or there is too much steam for the water flowing through the tube. It would appear that all one has to do is increase the circulation to prevent troubles, but such a viewpoint does not take into account the fact that a great many failures in water wall tubes are at the lower end where the water-steam ratio is as much as 200 to 1 and the velocities as high as 3 or 4 ft. per sec. Failures are often not in the upper end of the tube where the maximum steam volume actually exists.

For these chemists I should like to pose a question. First, let them determine and clearly set forth at least in their own mind the quality of feedwater which they feel able to provide. If this is less than perfection, then let it be frankly set forth. And then if they think that circulation is inadequate under the conditions which they can provide, suppose they try to find out what is adequate.

If, as frequently happens, they persist in saying that the heat input is high and therefore scale necessarily is to be expected, then let them actively search for the end point so that they will be able to say what amount of heat input is permissible with the type of water which they feel is commercially available.

While they are doing this, let them take into account the fact that economic questions enter into this problem. The owner wishes to obtain the maximum output from a given investment and necessarily there always has been, and will be, a problem of balance between the amount of circulation and rate of heat input on the one hand, and the quality of water which can and will be provided, on the other hand. The correct answer is the one which provides the over-all minimum cost of power production.

Corrosion

Several papers have been published on the question of corrosion in high-pressure boilers. Many of the examples have been of tubes that were nearly horizontal and in which the rate of heat input in comparison with circulation produced a layer of steam along the top side of the tube. This results in a characteristic oxidation which builds up a layer of sponge-like iron oxide. This acts as an insulator to decrease the contact between water and tube metal, so that there results an increasing rate of deterioration and failure in a relatively short time. This difficulty can be prevented by proper circulation or proper control of heat input or a combination of both.

There has been much argument about the desirable water conditions to have under such circumstances. I doubt if there is any conclusive evidence that these types of failures can be pre-

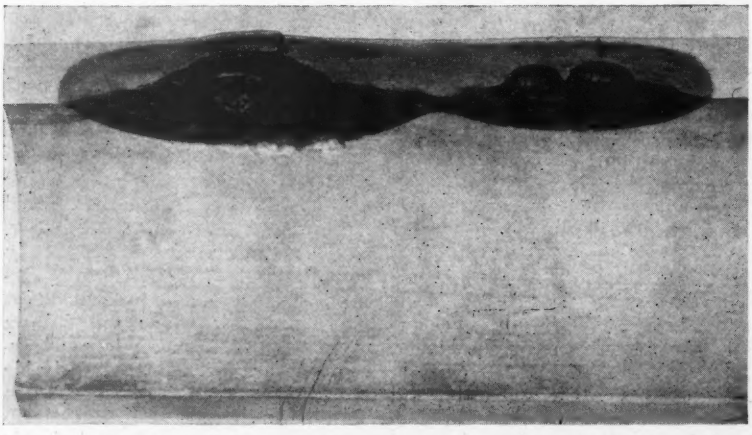

Fig. 2. Tube section showing the penetration of typical corrosion pits and the external areas affected. Pits range from 2 to 3 in. in length up to a foot. Chemists disagree as to the cause of this type of corrosion which appears in both hot and cold zones

vented by water conditioning. The phenomenon is rather common and apparently quite characteristic, and to prevent it one must either have a higher velocity of water or less heat input, or both.

There is, however, another kind of corrosion which has shown up particularly on the 900 and 1250-lb. boilers, which is quite different. There are a fair number of such units now in trouble. Figure 1 shows one manifestation of this trouble. Notice the deep pit. This may be 1 to 2 or 3 in. and in some cases a foot long.

They occur erratically. There may be one in a tube and none in the neighboring tubes. There may be several pits nearby. They have been found in tube ends, in the lower end of dry ash hoppers, in areas where the gas temperatures are down to 1500 deg. F., and where the tubes are vertical and the flow is high. They occur in water wall tubes and in boiler tubes, and are more than usually troublesome because they cannot be foreseen or discovered upon inspection, and therefore when they fail the outage is unscheduled.

A running argument is in process among chemists as to the cause of such corrosion, whether the pH value is too high or too low, and whether the concentration in the boiler should be more or less. Some argue that a high caustic content in the water induces this corrosion and yet a number of units of exceptionally clean interior with no corrosion at all are in operation with pH above 12. Others argue that high heat input is the cause. This does not account for these corrosion pits in water walls in cold zones.

In checking the history of high-pressure boilers, it appears that such pitting occurred on some of the first 1250-lb. units and still occasionally there is an eruption through such a pit. Whether it is an old one or whether the difficulty is still going on is almost impossible to determine.

Copper Deposits in Boilers

In nearly all high-pressure boilers there are fairly large quantities of copper. Sometimes this shows up as flakes of metallic copper, sometimes it is reported as copper oxide. I have found no one who is certain as to the source of this copper, nor the mechanism whereby it is removed from condensers or heaters in the feedwater circuit. Some think that ammonia, which will continue to redissolve if not specifically removed, is the cause of this transfer from non-ferrous tubes to the boiler water.

Some people have found that the condensed steam from the steam jet air pumps is heavily laden with ammonia and if this is pumped back into the system, then the ammonia is not eliminated. Throwing this small amount of condensate overboard will decrease this ammonia and may be helpful.

What the effect of this copper is upon corrosion is uncertain. It has been observed, however, that metallic copper almost invariably appears in large quantities with this type of corrosion. In some cases it appears to have found its way in to the grain boundaries of the steel at the bottom of the pit. I believe it important that all of us at this time pay particular attention to this problem. We should determine, if possible, whether this copper is a cause or an effect and I imagine the operators will be anxious to know where the copper comes from and determine if any appreciable damage is being done to other equipment.

Pulverizers

Pulverizers involve problems of combustion control, burner design, range of load, and efficiency. Some types use large quantities of primary air at a relatively constant rate irrespective of the coal loading, while others have primary air more nearly in proportion to coal flow. The area of coal pipes must of course be suitable for the volume of primary air and where the primary air and coal vary together, then the range of coal input is limited at the lower end by permissible velocities in the coal pipes.

When oversized pulverizers are specified, or, when tremendous differences in grindability of coal are encountered, it is exceedingly difficult to design burners which will operate satisfactorily over the range of conditions imposed. Some operators believe that the larger the mill, the better; and some buyers insist upon handling everything from 35 to 110 grindability with equal facility. This is difficult with standard equipment because within some reasonable range there is an optimum condition for perfection of combustion and as conditions depart from this, the results become less desirable.

Looking over recent experience in plant operation from the standpoint of feedwater treatment and related difficulties I conclude that:

1. The feedwater specialists have done a wonderful job in the last few years. However,

2. The operating organization should be particularly well equipped with technical men and apparatus to continuously check their feedwater conditions to prevent scale and corrosion; and

3. Chemists and research groups should wake up and realize that feedwater problems for high pressure boilers are only partially solved. This needs attention now, and I suspect, a tremendous amount of additional work before suitable answers are available.

Needless to say, fineness of pulverization has a bearing upon carbon loss and may have a distinct bearing upon the amount of iron sulphide formed in slag tap furnaces. In dry bottom jobs, fineness affects particularly carbon loss and this is noticeably so with low volatile coal.

Naturally an operator will know the design conditions for these various factors in both the pulverizers and the burners. He will profit by testing these on the actual installation to see if design conditions are being met and if for some reason they are not, then alterations may be made to make more acceptable the conditions which actually must be lived with in operation. This means that fineness should be checked periodically in order to know when balls or rollers should be changed or additional balls or new parts added in the pulverizer itself. Fineness can decrease rapidly under certain conditions and loss of efficiency may pile up without knowledge unless a routine for making such checks is arranged.

Mills and Burners Must Be Balanced

Nearly all medium and large sized jobs now operate with more than one pulverizer. If so, it is practically necessary to be sure that the coal output from each mill is substantially the same unless means are available for determining coal-air ratio for the set of burners from each mill. Such provision is very difficult and most installations are designed for uni-

(Continued on Page 72)

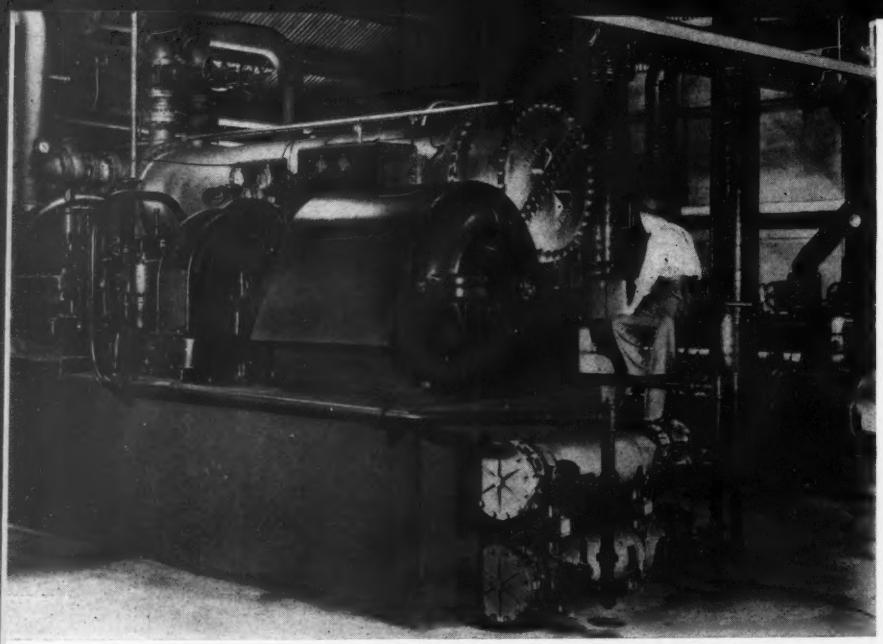

Fig. 1. A large motor driven refrigerating machine utilizing a variable-speed hydraulic coupling

DRIVES For Refrigerating Plants

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THE PROSPECTIVE purchaser of refrigerating equipment is often confronted with the selection of the drive to supply the required horsepower at the least possible cost consistent with dependability. In large plants overall operating efficiency can frequently be improved by judicious selection of the type of drive, and it may be possible to incorporate power factor correction or improvement of heat balance. The drive lowest in first cost does not always yield the most economical owning and operating charges; often the most expensive initially may produce later savings which will more than justify the added investment.

This survey of certain available types of equipment—electric motors, steam turbines and internal combustion engines—with a discussion of individual operating characteristics of each, may be helpful in directing consideration to the most appropriate type of drive for given conditions.

Motor Drives

Probably the most commonly used drive for reciprocating compressors up to 50 or 75 hp. is the squirrel cage induction motor which will produce the high starting torque required with across-the-line starting equipment. Where lower values of starting current are required, reduced voltage starters can be employed, or the special double stator winding squirrel cage type motor can be utilized. This motor has a supplementary winding for starting duty at full voltage and the starting current is substantially lower.

With this constant speed drive, compressor capacity can be varied by use of cylinder bypasses or clearance pockets. With the first method the discharge from one or more cylinders is diverted back to the suction, so that no compression occurs. A valve in each bypass line can be conveniently operated either manually or automatically to provide capacity control. Clearance pockets function by changing piston displacement in one or more cylinders and may also be operated manually or automatically. Suction valve control is another less common type which utilizes devices to restrict the action of the compressor suction valves.

The induction motor is also available with divided or multiple windings for two or more running speeds. In conjunction with automatic or manual starters, this provides another frequently used method of capacity variation, though at higher cost than either of the preceding systems.

Drives such as these are used extensively in all tonnage sizes and are readily incorporated in completely automatic installations. In the larger tonnages, 50 or 75 hp. machines can be used in multiple, and capacity variation is then easily accomplished by arranging automatic sequence control of the compressors through thermostats and pressurestats.

Above 100 hp. the synchronous type motor becomes favorable both for reciprocating and centrifugal compressors. The principal advantage gained by use of this type is the ability to improve plant efficiency by designing the motor for unity or leading power factor. This is of major importance where a

multiplicity of small motors and other electrical devices tend to lower the overall power factor to the point where lines are overloaded and losses are appreciable. Many power companies include power factor clauses in rate schedules which penalize users whose plant power factor is low, so that actual savings in operating costs may sometimes be realized.

Power factor correction can be obtained by the installation of capacitor banks and some types of constant speed motors are available where such capacitors are furnished as a part of the motor control.

With constant speed machines it is necessary to provide capacity variation directly on the compressors. This can be accomplished through the use of cylinder bypasses or clearance pockets in the case of the reciprocating, and by suction dampers or variable speed transmissions on the higher speed centrifugal compressors.

The engine type synchronous motor is particularly adaptable to the low-speed reciprocating machines since it can be designed for the same low speed as the compressor and hence can be directly connected. This type motor is built on an extension of the compressor shaft, and in spite of the large number of poles required to produce the low synchronous speed, the overall assembly is quite efficient and compact. Motor speeds of 1200 to 1800 r.p.m. are usually employed for application to centrifugal compressors, and the higher speeds of approximately 3000 to 7000 r.p.m. are produced through the use of a gear transmission. Capacity control of centrifugal refrigerating machines driven by constant speed motors can be provided inexpensively by use of a dampering device known as the suction damper. Installed in the compressor suction, it may be regulated manually, or by a pneumatic or electric damper motor which can be actuated by a thermostat. The characteristics of a centrifugal compressor are related to a centrifugal fan, and the effect is therefore akin to an inlet vortex damper in a fan. The overall efficiency when throttling down to comparatively small increments of capacity compares favorably but is somewhat lower than that obtained with variable speed control through slip-ring motor drive. This capacity control may also be utilized with any constant speed drive, and is often combined with variable speed drives to provide additional flexibility of performance.

Variable speed operation of centrifugals in general gives somewhat better efficiency than the suction damper at part loads. The simplest form of variable speed drive is the slip-ring or wound rotor motor, equipped with a bank of resistors operated by a manual drum switch. An inherent advantage of this motor and control is the low starting current required without special equipment. The standard drum resistor, however, is not particularly adaptable to automatic control, although actuating mechanisms have been devised for automatically changing the resistor value. Another starting arrangement is available which replaces the conventional resistor grids with a liquid rheostat which lends itself readily to automatic regulation. Consisting essentially of tanks containing electrolyte and two electrodes, the resistance introduced is varied by changing the area of submersion of one of the electrodes in the liquid. One tank is required for each phase, and the moving electrodes are controlled simultaneously by a pilot motor which may be thermostatically operated. The electrolyte, a solution of sodium carbonate, is circulated by a pump from the tanks to an interchanger, where the heat developed by the current is yielded to the cooling water.

The eddy current clutch is another recent development which is finding a place in connection with constant speed motors. It consists essentially of two rotors, one mounted on the motor shaft and the other on the compressor gear shaft. The rotors are wound with coils similar to those in a motor, and revolve one inside the other. An exciter current is applied to the outer rotor and as lines of force are generated within the field of the inner rotor, a torque is applied to the inner rotor. The value of transmitted torque is dependent on the strength of the field and speed control can therefore be obtained by variation of excitation current intensity. Automatic speed variation is achieved by the use of a multipoint rheostat mechanically actuated by an air or electric motor responding to a thermostatic element in the brine line. Automatic unloading of the machine is simplified since the driving shaft rotates entirely without drag in the absence of an excitation current. A simple time delay relay in the field circuit, energized by the main motor current, prevents picking up load until full motor speed is realized. With selection of an adequate number of resistance steps, any increment of load can be handled, and even at times of no load, if of slight duration, the main motor can be permitted to idle, practically at the cost of friction losses only.

The hydraulic coupling is another type of variable speed transmission similar in effect to the electric clutch and provides the same advantages. Known as the fluid drive it is now being offered on several models of passenger cars. This device has been in use for several years and has found extensive use in mining operations for driving ventilating fans.

A vaned rotor rigidly attached to the input shaft, rotates in close proximity to a second vaned rotor which is rigidly attached to the output shaft of the coupling. Both rotors are contained within a housing into which oil may be introduced. As oil begins to reach the outer edge of the driven rotor, it is picked up by curved vanes which direct the stream of oil out from the driving rotor. The reaction of the jet against the vaning of the

The problem of selecting the proper type of drive for a refrigerating machine is not a difficult one but it demands a careful study and consideration of the conditions that exist in any particular plant. With high-speed machines the motor drive, offhand may seem the simplest solution and in many instances this will be the most desirable type of drive, but if, for example, a considerable amount of steam is available, even though the pressure of the steam may be no more than atmospheric, a steam turbine or steam engine may prove the best type of drive. In some instances power factor may be an important factor in the selection of the drive or again it may involve a question of heat balance. Consideration of the drive problem involves a study of coupling devices—gears, hydraulic and magnetic speed reducers, etc. Many of these on the market these days may make it possible to adapt an existing drive to a new refrigerating unit. As indicated by Mr. Macrow in this article on the subject of drives, the question of initial cost should not be a determining factor. The penny-wise, pound foolish principle holds here just as it does in the purchase of any other more or less permanent machine or device

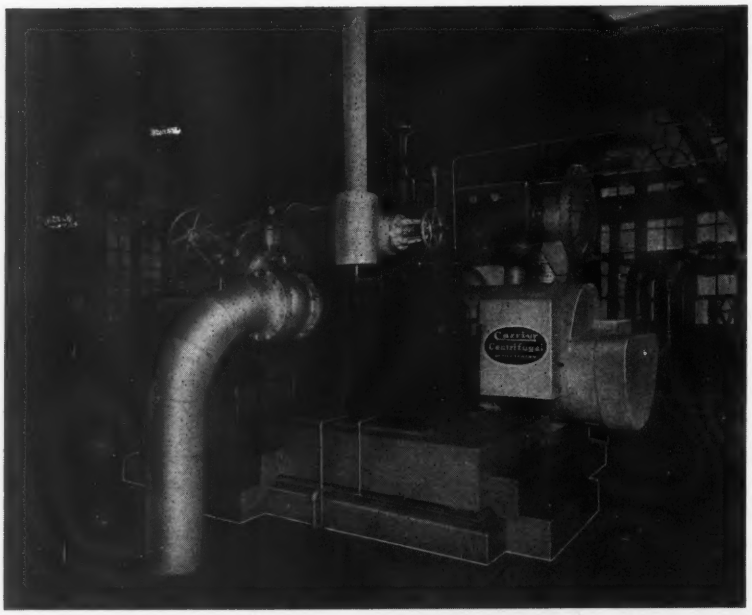

Fig. 2. (Above) A steam turbine driven centrifugal compressor

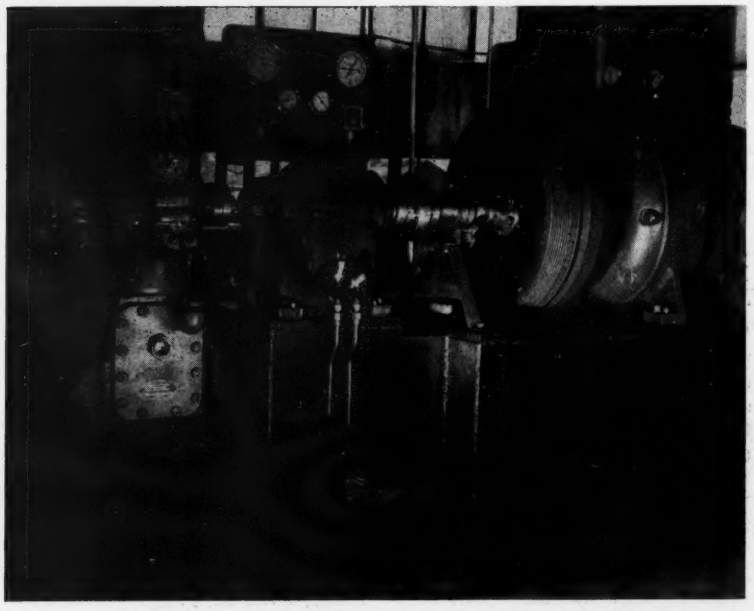

Fig. 3. (Right) This refrigerating machine in a large textile mill uses an eddy current type of magnetic clutch. Speed control is obtained by varying the excitation of the clutch windings

driven rotor produces rotation. As the volume of oil is increased the area of the vanes covered by oil increases, and the transmitted torque then becomes a function of the volume of oil contained in the transmission chamber.

Automatic control is equally simple, being accomplished by the use of two automatic valves thermostatically controlled, which admit or relieve oil from the transmission chamber. Per cent torque is a function of the volume of oil contained in the chamber, and therefore automatic speed variation is readily achieved.

Turbine Drives

When steam is available, it can be utilized at almost any initial pressure and back pressure because of the large variety of turbines available. In general, this type of drive, inherently a high speed device, is better adapted to centrifugal compressors because the speeds of the compressor and turbine, ranging from 3500 to as high as 7000 r.p.m., can be matched and no speed increaser is required. Elimination of the gear or belt drive represents a distinct saving in total horsepower. Reciprocating compressors, which require speeds of around 300 to 500 r.p.m. in the larger sizes, can be arranged for turbine drive through the use of reduction gears. Two steps are often necessary because the high speed ratio required produces an excessively large driven gear. A V-belt drive in conjunction with a gear reducer has been used successfully, but the transmission losses are higher.

When steam drive is required for reciprocating compressors, reciprocating steam engines are suitable. These are available in many types, both horizontal and vertical, and can be readily designed for direct connection. The uniflow engine is one type which is particularly adaptable and is popular because of its relatively high efficiency.

Turbine drives are usually higher in initial cost than motors but operating cost is often substantially lower, and when used as a reducing valve in the heat balance of a plant, the cost of operation is extremely low. Such an example is found in brewery practice where steam is generated or purchased at a high initial pressure, but a large proportion of the steam is required at a lower pressure for process heating. The energy otherwise dissipated in a reducing valve can be turned to useful work in a back-pressure turbine, and if various steam pressures are required for processes, these can be readily provided by use of a bleeder or mixed-pressure turbine in which steam at various pressures can be taken off the turbine after one or more stages as desired.

Low cost refrigeration is obtainable in many power plants by putting exhaust steam to work at pressures as low as atmospheric. A low-pressure condensing turbine is utilized for this service and requires means for condensing steam at a vacuum. A surface condenser is frequently utilized when condensing water is recirculated, and is usually connected in series with the refrigeration condenser. The water on leaving the steam condenser is returned to a cooling tower, or spray pond. Where a constant supply of river or other water is available in large quanti-

ties, the lower cost jet or barometric condensers are suitable, and may be used in a similar arrangement, except that the water is discarded or re-used elsewhere.

Generating plants equipped with non-condensing reciprocating engines are especially suited for the addition of this type of turbine installation. The operating conditions of the existing engines need not be changed, even though exhaust may be at atmospheric pressure. In addition to amortization, practically the only operating cost chargeable to the new equipment is that of furnishing the condensing water and power for pumps and auxiliaries.

Low Rates Are Beneficial

Turbine drives should be particularly considered where steam is available during the refrigerating season. Buildings served by district steam plants can often negotiate substantially lower rates all year round by maintaining a more uniform yearly demand. Many steam companies welcome the opportunity to build up an off peak load for boiler plants designed for winter heating. The low rates offered are mutually beneficial since the boilers may otherwise operate at inefficient fractional capacity in summer. Some steam companies, however, are also in the electric power business and will not furnish steam for power, preferring to carry the load on their generators.

District steam is ordinarily distributed at pressures of about 100 psi. and high-pressure condensing turbines are suitable. Condensate is usually discharged to the sewer and must therefore be cooled to approximately 140 deg. F. or lower according to requirements of the local codes. Condensers are therefore usually designed for about 28 in. vacuum to approach this temperature. Further cooling of the condensate is often accomplished by using it as a preheating medium for hot water systems and this extracts about the last possible B.t.u.

Buildings having their own boiler plants can also utilize turbines for summer refrigerating capacity at low operating costs. Here again, a steam generating plant can be used which may otherwise lie idle in summer.

Internal Combustion Engine Drives

Not the least important prime movers are the reciprocating compression engine types, which are available to operate with fuel oil, natural gas or gasoline. In some locations one or more of these fuels may be cheaply abundant; in others electric power or steam may be more expensive or unavailable. In such cases the use of engine drives is justified in spite of the somewhat high initial and maintenance cost as compared with motors or turbines.

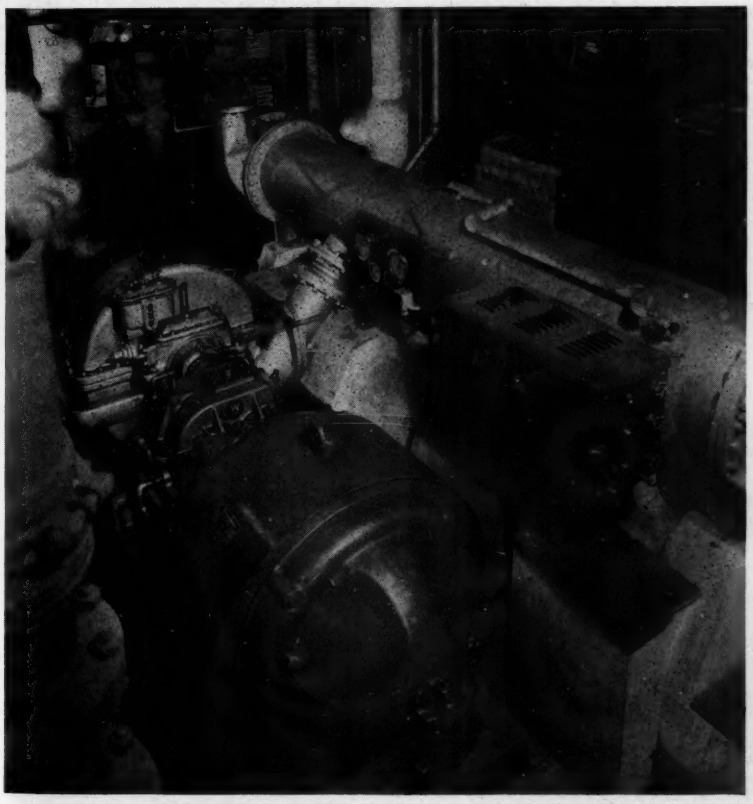

Fig. 4. A compact motor drive using reduction gears

Use of Gear Transmissions or Belted Drives

When the operating speeds of compressor and engine are approximately equal they are directly connected, thus eliminating transmission losses. Gear transmissions or belted drives may be used in other cases. Reciprocating compressors are usually equipped with unloading devices for ease of starting; clearance pockets or cylinder bypasses frequently serve this purpose. Hydraulic couplings or eddy current clutches may also be employed, but usually a simple mechanical clutch is used since the variable speed control can be applied directly to the engine throttle.

Three of the most important types of commercially built engines suitable for compressor drives are the Diesel, gasoline, and gas engines. The first operates on fuel oil, and is available in capacities from about 50 hp. to well over 1000 hp. The gasoline and gas types are practically identical except for carburetion and are built in sizes ranging from fractional horsepower units to multi-cylinder engines over 1000 hp. Gasoline engines are employed extensively in portable refrigerating plants for truck and bus air conditioning, also in railroad car and airplane precoolers. Air cooled or evaporative condenser fans are also driven from the compressor engine, and compact arrangements are possible with a minimum of dead weight.

It is beyond the scope of this discussion to deal in actual initial and operating costs, but the need for a careful analysis of available sources of power and a consideration of the effect on plant economy is clearly indicated.

Such a study usually pays dividends in operating costs which may more than justify the cost of the necessary survey even when this is performed by an outside consultant. The value of procuring recommendations from a consulting engineer should not be underestimated since the independent and unbiased judgment which he can bring to bear may often yield ideas otherwise overlooked.

KEEP

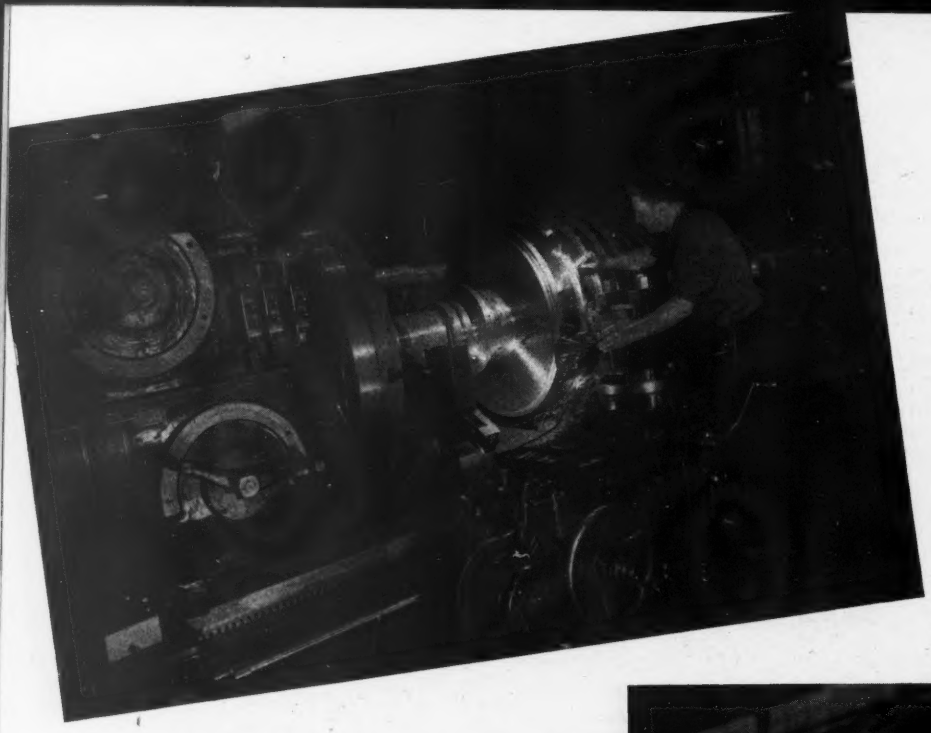

Fig. 1 (Left) The manufacture of steam turbines involves all the special skills of metal working—casting, forging, machining, welding. Here a workman measures the dovetail dimensions of a turbine rotor in a large lathe. Rows of buckets will be fitted to the peripheries of these wheels to form the complete moving turbine rotor

One of the best ways to get a clear picture of the operation of propulsion equipment is to see it manufactured before it is installed in the ship's hull. In the photographs on these two pages, taken in the shops of the General Electric Co., are shown various steps in the production of this very important class of war equipment. Propulsion sets of the geared-turbine and the turbine-electric types are manufactured by General Electric for all types of merchant ships. Three shifts a day maintain an accelerated production program that speeds the flow of equipment for these merchant bottoms from shop to shipyard. Fundamentally, turbines for ship propulsion are no different than turbines for land use, but their rapid rate of production make these views of interest

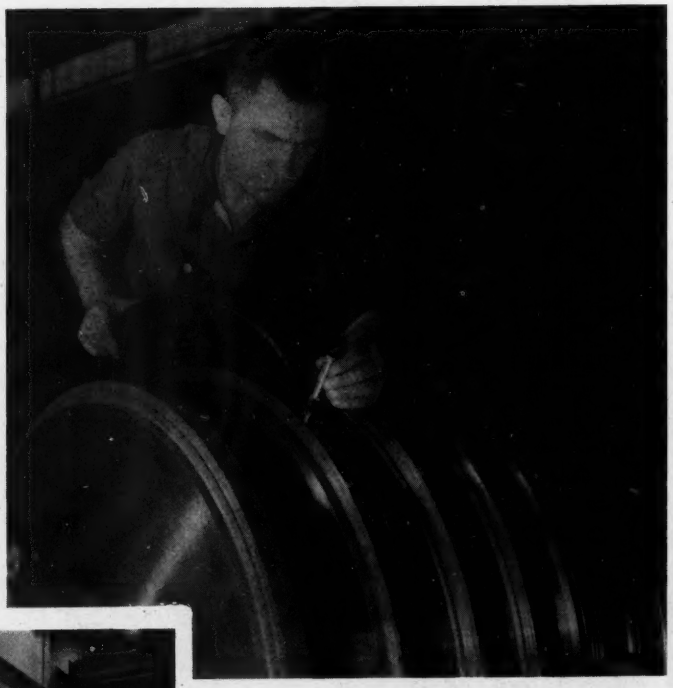

Fig. 2 (Above) Check and test is the formula that makes for lasting efficiency in operation. Precision instruments verify the accuracy of machines and men during every stage of manufacture of all turbine parts. In this view a workman is using a micrometer to measure the outside diameter of the turbine rotor wheels

Fig. 3 (Left) Power for land and sea. Stators for four 6000-hp. ship propulsion motors form the background for sections of a big generator to be installed at an important hydroelectric project. Such propulsion motors are for electric-drive ships where the turbine is direct connected to a generator furnishing the electrical energy to drive the propeller motors

'EM SAILING

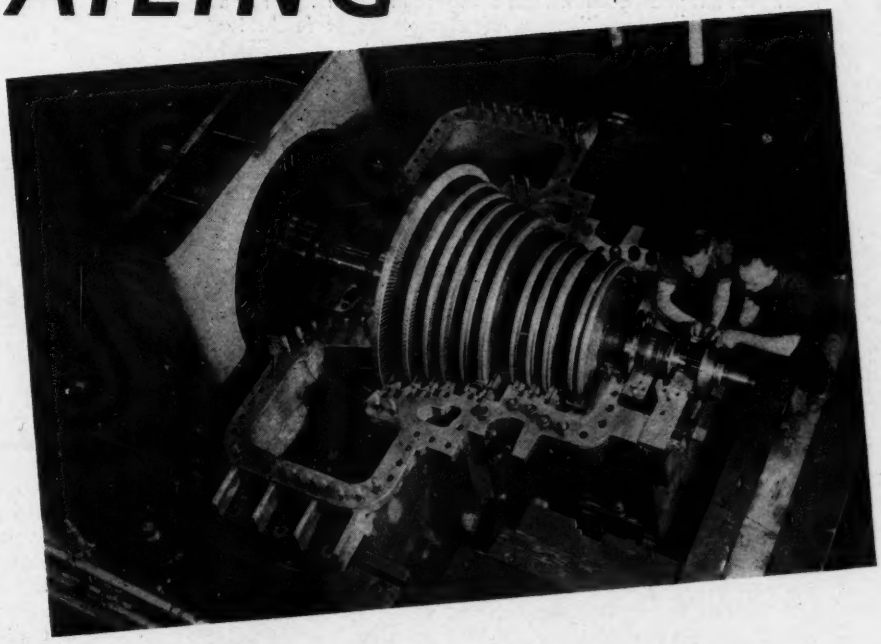

Fig. 4 (Right) Thousands of separate parts fabricated into more than a score of subassemblies make up the turbine. In this one, being prepared for test prior to shipment, the top half of the casing is yet to be put in place. This turbine is direct-connected to an electric generator which will produce power for a propulsion motor on an electric-drive ship. Note the labyrinth type of seal between the first bucket wheel and the forward bearing. This seal prevents the high-pressure steam from leaking out between the shaft and the turbine casing

Fig. 5 (Left) This geared propulsion set being assembled in the ship will be given a test run under conditions similar to those aboard ship. The high-pressure rotor is being lowered, and the low-pressure rotor is shown already in position. The gears are shown in the rear foreground

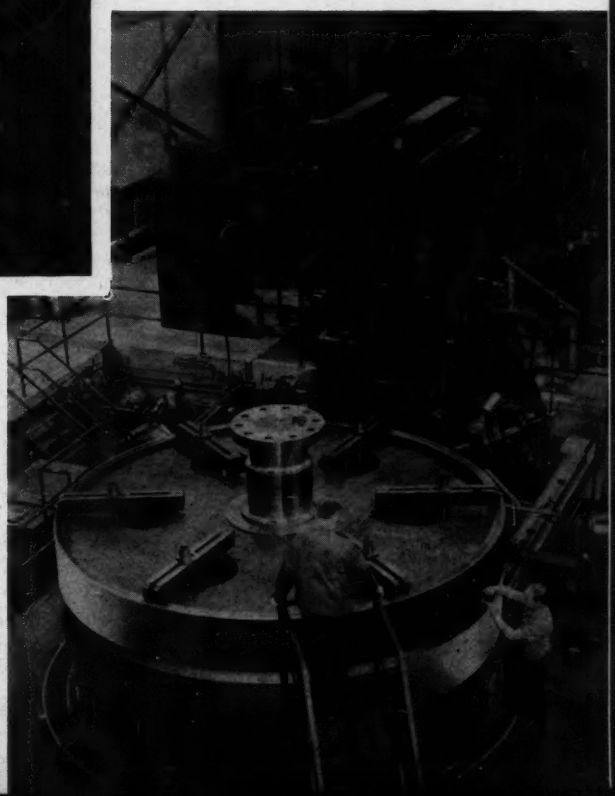

Fig. 6 (Right) The production of gears and pinions for geared-turbine ships is a painstaking task. Large hobbing machines such as the one shown here cut teeth in bull gears up to 35 tons and 200-inch diameter to a tolerance of 0.0003 in. Rough and finish-cutting of these gears requires 285 hr. The hobbers used in the cutting of these gears must be of extreme precision. Finish cuts must be made without interruption and elaborate precautions are made to see that the operation is continuous under any and all conditions. A special emergency storage battery power supply is provided with automatic control equipment to cut it in instantly should the main source of power fail. A duplicate lubricating system is also always ready for emergency use. These gears are necessary to transform the high speed of the propulsion turbine into a slower propeller speed

Part I. As a result of increased boiler pressures and temperatures as well as changes in details of boiler construction, water treatment has undergone marked changes. In this first part of a two-part article, the objectives of all methods of feedwater conditioning are described briefly. Part II, to be described later, will deal with typical methods of water conditioning

Conditioning Feedwater For High-Pressure Boilers

By *Austin C. Dresher*, *Cochrane Corporation*

METHODS for conditioning boiler feedwater have undergone marked changes in the past 10 yr. For such a relatively low boiler pressure as 150 psi., the ordinary lime and soda softener, or the zeolite softener in combination with an open heater, was adequate, but with pressures up to or exceeding 2000 psi., it is no longer merely a matter of softening; other considerations must be taken into account.

In order that heat may be transmitted, the temperature of the boiler tube must exceed that of the water, the excess increasing with rate of heat flow and with resistance to heat flow. The excess of metal temperature permissible for carbon steel tubes at different boiler pressures is shown in Fig. 1. Thus, at 250 psi. the permissible difference between the temperature of the metal and that of the water inside of the tubes is 500 deg. F., whereas with 1500 psi. pressure this difference drops to 300 deg. It is clear that with high pressures tubes must be kept absolutely clean, if failures from overheating are to be avoided.

Requirements of a Balanced Treatment

The objectives of all methods of feedwater conditioning, briefly, are as follows:

1—Maintenance of cleanliness of evaporating surfaces:
By reducing calcium and magnesium salts in the feedwater to low limits and by preventing the formation of adherent sludge or scale in the boiler.

2—Protection of economizers and boilers against corrosion:
By holding proper pH values and by reducing dissolved oxygen to low limits.

3—Prevention of carryover:
By so reducing and controlling solids and alkalinity in the boiler water as to minimize foaming and priming.

4—Protection against embrittlement:
By the maintenance of a chemical environment in the boiler water concentrate that is non-embrittling, according to criteria established by recent investigations.

5—Low cost of installation and operation.

Maintenance of Clean Evaporating Surfaces

Accumulations of sludge, dirt and scale result from concentration of calcium, magnesium and silica impurities by evaporation. The blowdown schedules of high-pressure boilers will average 5 to 10 per cent of the make-up water, which means that the make-up water will be concentrated 20 to 10 times. This concentration, together with the change in chemical characteristics at high temperatures, promotes precipitation of the salts, which adhere to the heating surfaces unless corrective treatment is applied. The solubility of calcium sulphate, for example, is around 100 gr. per gal., or 1700 p.p.m., at room temperature, decreases rapidly with increase in temperature, and at 1500 psi. pressure is only a few p.p.m. The problem, therefore, is to remove the scale-forming salts before the water enters the boiler and to produce such an environment within the boiler that the residual hardness not removable by chemical treatment of the feedwater will be precipitated as a non-adherent, easily removable sludge.

Besides calcium and magnesium, attention must also be directed to the removal of silica, which, if allowed to accumulate uncontrolled, will form a hard, dense scale that may not respond to any internal chemical treatment. The amount of silica entering with the feedwater must be limited more and more as the pressure increases. For example, at 100 to 150 psi. steam pressure, up to 200 gr. per gal. of silica in the boiler water concentrate may be permissible, or approximately 3500 p.p.m.

On the other hand, as pressures are increased this limit must be markedly decreased to avoid the danger zone of precipitation, so that at 600 psi. it is common to hold the silica below 60 p.p.m., and at 900 psi. pressure at about 40 p.p.m. At 1500 psi. pressure great care is taken to reduce the silica to not more than approximately 25 p.p.m. These are not definite and specific figures below which trouble will be avoided, or above which silica scale will form, but, rather, they are limits customarily observed.

Natural water supplies contain around 5 to 8 p.p.m. of silica, although in certain districts, particularly where well water is used, the silica concentration in make-up water may reach 15 to 25, or even as high as 60 p.p.m. It is impossible to correct for so much silica by treating the water inside the boiler and the silica must, therefore, be removed before the water enters the boiler. Silica can be removed from feedwater in a variety of ways, either hot or cold. In the cold process, coagulants are used, such as ferric sulphate, aluminum

sulphate and magnesium sulphate or bicarbonate. In the hot-process softener, the silica is most effectively removed by the use of magnesium salts. Fortunately, the magnesium hardness in most water supplies is sufficiently high to reduce the silica appreciably with simple lime and soda ash treatment, or, if it is not high enough, additional magnesium can be added in the form of magnesium sulphate, Dolomitic lime or magnesium oxide. Where silica removal plants are installed as part of the feedwater treating equipment, it is customary to reduce silica to around 1 to 3 p.p.m.

Protection Against Corrosion

Corrosion of iron and steel is governed by:

1—Temperature.
2—pH value.
3—Concentration of dissolved oxygen.

Rise in temperature accelerates the union of oxygen with iron much as it does most chemical reactions. The amount of oxygen dissolved in the water generally determines the amount of corrosion that can take place, whereas the pH value, which expresses acidity or alkalinity of the water, governs the speed of corrosion. Obviously, the only factors controllable in boiler feedwater treatment are the pH value and the oxygen concentration. Mechanical deaerators have been developed to the point where zero oxygen, as measured by the Winkler test, is guaranteed, and with a suitable feedwater conditioning process the pH value can be controlled.

Although not necessary with suitable equipment properly operated, mechanical deaeration is sometimes supplemented by chemical reagents, such as sodium sulphite, ferrous hydrate, etc. Sodium sulphite is, however, becoming increasingly difficult to obtain, so that more attention must be given to mechanical deaerating equipment.

High-grade deaerating equipment is mandatory for high-pressure boilers, particularly those having steel-tube economizers, as the present tendency in feedwater conditioning is to maintain low alkalinity in the boilers and lower pH value in the make-up water, so that with higher temperatures in the economizer sections it is highly desirable to hold the oxygen to the lowest possible value.

Carryover

While high rates of evaporation, design of boiler and character of load all play a part, carryover, insofar as the conditioning of the feedwater is concerned, is influenced by these four items:

1—Alkalinity.
2—Total solids.
3—Organic matter.
4—Sludge.

The alkalinity of the boiler water concentrate can be controlled in a number of ways, namely, by adjusting the amount of chemicals used, by recirculation of concentrated boiler water, and by blowing down.

The amount of sludge, obviously, can be controlled by the selection and operation of the feedwater conditioning system, and means for reducing the hardness to less than 1 p.p.m. are today available.

The total solids can be controlled only within the limits set by the impurities originally present in the make-up water, although with the newly developed carbonaceous zeolite softeners, practically all of the mineral salts can be removed, placing this type of softener in this respect on a par with evaporators.

While silica must be controlled in order to prevent scale, it must also be controlled to prevent deposits on turbine blading. As carried over in the boiler water concentrate, silica seems to adhere to turbine blading more tenaciously than do other salts. A boiler water of relatively high silica content, but low in other mineral solids, may cause more trouble from turbine-blade deposits than will a boiler water containing the same amount of silica but high in other mineral salts. For example, Straub points out that if the ratio of sodium sulphate to caustic soda is 3 to 1, deposit on turbine blades is not likely to occur, whereas if the ratio is less, the caustic soda, because of its higher melting temperature, will adhere to the blades, while the sodium sulphate at high temperature and under the drying action of the superheater, will become dust, which, if in sufficient quantity, will prevent adherence of the caustic. It is said that turbine blade deposits have been definitely prevented in the State Line Station by following Straub's recommendation of a relative high ratio of sodium sulphate to caustic.

Even with distilled make-up in high-pressure plants operating at 1400 psi., danger of deposits of silica upon turbine blades through carryover is not removed. For example, at a large central station, it was found that carryover from the make-up evaporator introduced a small quantity of silica into the

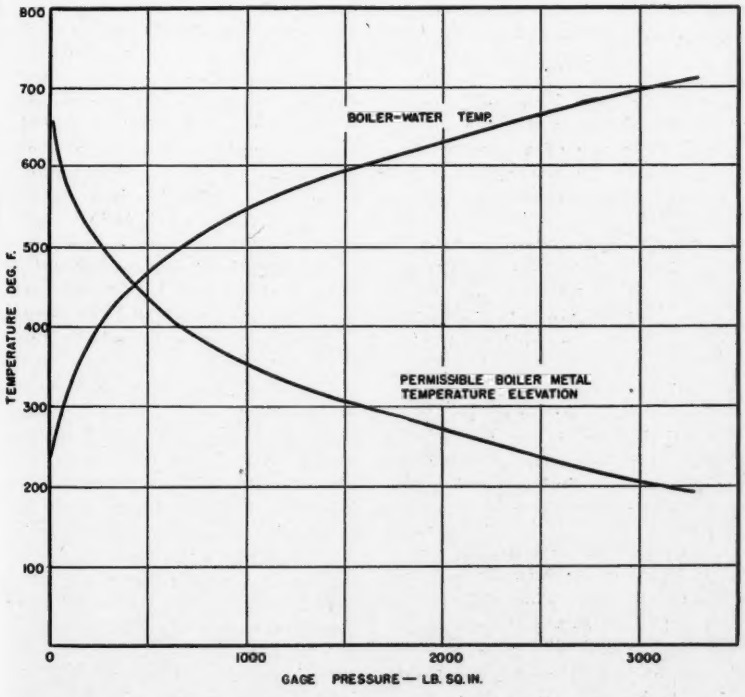

Fig. 1. Excess temperature difference permissible between boiler water and carbon steel boiler tubes

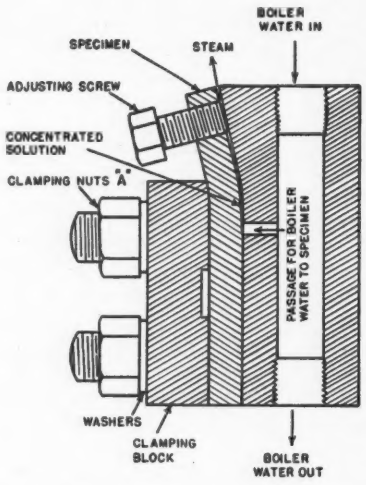

Fig. 2. Schroeder Embrittlement Detector

boiler feed, and this carried over from the boilers to the turbine to form tenacious silica deposits.

Carryover is commonly prevented by the installation of steam-washing equipment and by judicious blowing down, the latter being controlled by continuously testing the conductivity of the condensed steam. Equipment is available for degasifying the steam sample, to eliminate carbon dioxide, ammonia and other gases that would interfere with the measurement of total solids by conductivity, thereby displacing the older calorimeter method, which is not practicable at high pressures.

Protection Against Embrittlement

Embrittlement of boiler metal has been the subject of much controversy. Originally, embrittlement failures were ascribed solely to caustic soda, together with overstressed boiler plates, and many research tests seemed to confirm this theory. In recent years it has come to light that silica, an impurity in the caustic soda used in this research, was responsible for the embrittlement failures. Pure caustic soda, as manufactured by the electrolytic process or of reagent quality, does not produce the embrittlement demonstrated with commercial caustic soda made by the lime and soda process. The amount of silica required to produce embrittlement is very small indeed; as a matter of fact, the control of embrittlement by commercial methods of removing silica is not practicable and other means must be resorted to.

Since the adoption of the A.S.M.E. Code calling for the maintenance of certain ratios of sulphate to alkalinity, inhibitors other than sulphate, namely, phosphates, tannins and lignins, have been suggested. While these have been successful in many cases, they cannot be depended upon universally.

Testing for Embrittling Qualities

Although embrittlement was a very live subject about 10 yr. ago and numerous cases of failures are on record, no high-pressure boilers utilizing welded drums have failed in this way. The present procedure is actually to test for embrittling qualities the water being used. This is done by means of an embrittlement detector, the design of which was first proposed by Schroeder during his work at the Eastern Experiment Station of the U. S. Bureau of Mines, at College Park, Md. This ingenious device, shown by Fig. 2, simulates conditions that exist in the seams of the boiler. The boiler water is permitted to leak between the instrument and the specimen, the leakage being regulated by the adjusting screw. This leakage permits the concentration of the solution as indicated and duplicates conditions existing in the actual boiler seams. After 3 wk. the specimen is removed, tested and examined through a microscope for embrittlement failure. If the specimen is unaffected, the test is repeated and if no sign of embrittlement then occurs, the water is termed non-embrittling and the conditions as to chemical character are maintained. The use of the embrittlement detector is generally continued and the specimen examined periodically.

If the specimen should show signs of embrittlement, adjustments are made to change the chemical character of the boiler water concentrate, as by addition of lignins, maintenance of a different sulphate-carbonate ratio, etc., until the water becomes definitely non-embrittling, after which the chemical qualities of the water are maintained as indicated by the test. While this is a matter of cut and try, numerous tests have been run at a variety of plants and it is quite likely that in the not too distant future these experiments will be catalogued as a valuable guide to those exact chemical qualities of the water that have shown themselves to be non-embrittling.

(To be continued.)

WHAT THE OPERATOR WANTS TO KNOW

(Continued from Page 63)

form secondary air admission, which presupposes uniform coal admission both between burners on each mill and between mills.

It is not at all uncommon to find the coal leaving the mill, if of a pressure type, or, leaving the exhauster if of the suction type, being unbalanced between mills or between burners to the extent of between 10 and 15 per cent. This is not desirable from the standpoint of efficiency in carbon loss, not to mention uneven heat distribution across furnaces and at the entrance to superheaters, or unevenness of radiation to radiant superheaters.

Most of us have been brought up to constantly decrease our excess air to save dry gas loss at the outlet of the unit and if this is to be carried to the maximum, then, to prevent low excess air or high quantities of CO in certain parts of the furnace, it is necessary to know how to check for and maintain uniformity of coal distribution between burners and mills.

Many problems of combustion control also hinge upon having an arrangement such that increases or decreases in fuel input may be uniform as between mills and burners. This means synchronized feeders or synchronized primary air flow control and splitters or dividers in exhaust pipes so arranged that they perform uniformly with varying flows. Many times one side will be heavy at one rating and the other at another. I venture to say that a majority of plants can have their coal distribution improved.

(To be continued)

Science beat guesswork better than five to one in finding new oil fields in 1941, the best record made since figures have been kept.

One out of every five wells drilled last year on the basis of technical advice in the hope of finding a new oil field was successful. Only one of every 27 which was drilled because of a hunch, a doodle-bug, or some other odd reason found oil.

Scientific exploration is used in locating most wells in unproved areas today. A single oil well costs anywhere from $25,000 on the average up to $150,000 and more, and even with the help of science the chance of finding oil is only one to five.

Part II. In this second and last article of the series, the first of which was published in the July issue, the lubrication problems in the maintenance of air compressors and electric motors are given consideration. The author includes recommended specifications for these types of equipment[1]

The Part of Correct Lubrication in Equipment Maintenance

By SAM S. HANSEN
Chief Lubricating Engineer
General Petroleum Corp. of California

CARELESS maintenance of air compressors frequently results in dangerous explosions and fires. There are many mature mechanical men who harbor the mistaken idea that automatic blow-off valves are perfect insurance against explosions, and that they occur solely from pressure built up from the air delivered by the compressor itself.

The explosions which are "dynamite" are the ones which result from the spontaneous combustion of oil vapors which have been allowed to accumulate in the receiver tank and discharge system. Oxygen has a powerful affinity for the hydrocarbon compounds (of which oil is composed) and, when the chemical union occurs, the resulting explosion (under proper conditions of pressure) is both actually and literally more powerful than dynamite, T.N.T. or nitroglycerine. Pressure relief valves on receiver tanks are of little consequence when this occurs.

In one case the writer can remember the complete destruction of two large industrial buildings which resulted from the explosion of a moderate sized industrial compressor and where air pressures were carried at the normal 100 psi.

In the average compressor delivering air at from 100 to 150 psi., the air is normally discharged at a temperature ranging from 250 to 300 deg. F. If excessive quantities of oil are fed to the compressor cylinder, or if the oil in use is too heavy, it has a tendency to build up sticky, viscous deposits around the hot discharge valve. These gummy deposits gradually accumulate dirt and dust from the intake air, and these materials accelerate the formation of deposits around the discharge valve and through the discharge ports.

A small flake of "carbon" may prevent proper closing of the discharge valve. This results in blow-by of the high-pressure air back into the cylinder on the suction stroke. This constant "wire-drawing" of compressed air through the valve, plus the effects of recompression and abnormal pressures because of the congestion in the discharge ports results in temperature increases. This, in turn, facilitates more rapid deposit formation. These deposits begin to glow and burn.

The writer has visited plants where these red hot discharge ports, coupled with smoky discharge air, were considered normal, and were corrected only after rupture of the discharge ports and pipes because of the weakening effect of prolonged excessive temperature.

In severe cases where excessive quantities of lubricating oil are being fed, oil and oil vapors accumulate in the receiver tank. Here they are intimately mixed with oxygen and only await the arrival of an incandescent spark from the discharge port to set off the explosion which may kill workers, destroy buildings and equipment, and start fires.

Fig. 1. To lubricate these air compressors, oil is fed to the 26-in. low-pressure cylinder at the rate of five drops per minute and to the 13-in. high-pressure cylinder at 2 drops per minute

[1]CORRECTION NOTE: Mr. Hansen has called attention to errors that appeared in Part I of this article. In the specifications for lubricants given on page 87 of the July issue symbols used in specifying viscosity are given in inches instead of seconds. Where in. appears in these viscosity specifications it should be changed to sec. These errors appear in specifications (1) a; (2) a; (3) 2.a; and (3) 3.a.—Editor.

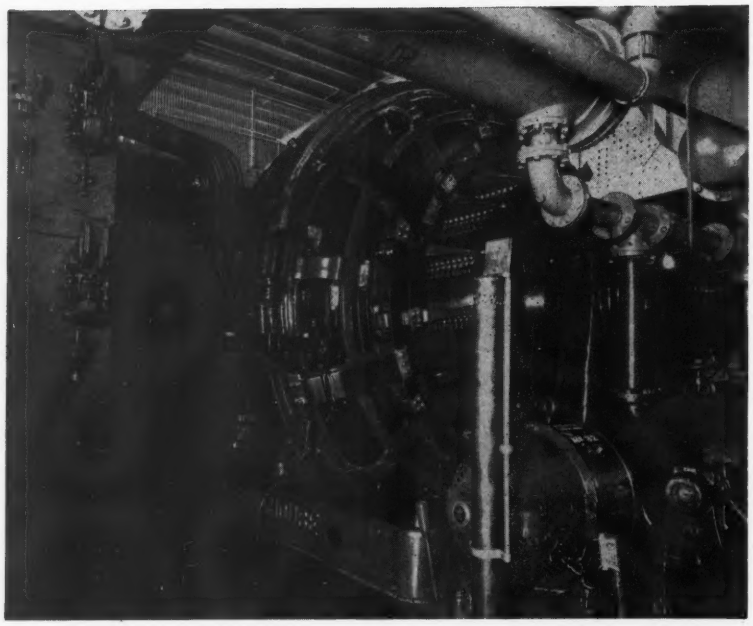

Fig. 2. This 2700-hp. d.c. variable speed motor has seen long service driving a 30-in. dredge pump at speeds varying from 250 to 350 r.p.m. Its present excellent condition is evidence of careful maintenance

Expensive labor for repair of compressors, cleaning and replacement of parts, excessive power bills, high lubricating oil consumption, fires and explosions can all be prevented by following a few simple operating rules. It is under the stress for maximum production that these things occur, and it is therefore doubly important during these busy times that a concerted effort be made to improve maintenance and not to overlook it in the rush for production.

The simple rules for safe, efficient air compressor operation are easily apparent, and are axiomatic with the experienced engineer:

1. Use cool, clean intake air. Install air filters and be sure they are maintained at regular intervals.

2. Feed the proper amount of a high quality compressor oil. Most operators use too much oil, and a qualified lubricating engineer can be a big help on this point.

3. Keep scale out of the water jackets. Install thermometers on ingoing and outgoing water to be sure heat transfer is not impeded.

4. Blow down the receiver tank every 24 hr.

5. Check the condition of pressure gages occasionally.

The writer has been in enough rubber plants, flour mills, woodworking plants, machine shops, aircraft factories, ceramic plants, potash and chemical plants, sawmills, textile mills, mines, ships and factories since the defense program started to know that in many cases these things are not being done.

Are you sure that your own compressor plant is being correctly operated, and is not on the verge of blowing a wall out of your plant?

Lubricants for Air Compressors

For air compressors producing pressures up to 150 psi., use an oil with the following general characteristics:

a. Viscosity at 100 deg. F—280 to 325 sec.; at 210 deg. F.—47 to 55 sec.
b. Gravity—24 to 30
c. Flash—370 to 430 deg. F.
d. Fire—390 to 460 deg. F.
e. Pour Point—0 to 15 deg. F.
f. Color—1 to 3
g. Carbon Content — 0.05 to 0.20
h. Neutralization Number—0.005 to 0.02
i. Additive—Optional

The only other governing factors here are to have an oil which is closely fractionated and has as high a flash point as possible consistent with correct viscosity. This oil must also resist the formation of gummy or hard carbon deposits on hot discharge valves.

For air compressors producing pressures over 150 psi. in two or more stages an oil of the general physical characteristics as given below should be used:

Temperatures between 140 and 180 deg. F.

a. Viscosity at 100 deg. F.—600 to 750 sec.; at 210 deg. F.—55 to 65 sec.
b. Gravity—24 to 30
c. Flash—400 to 460 deg. F.
d. Fire—420 to 500 deg. F.
e. Pour Point—0 to 20 deg. F.
f. Color—1 to 5
g. Carbon Content — 0.01 to 0.65
h. Neutralization Number—0.005 to 0.01
i. Additive—Optional

In this case an additive is necessary to enable the oil to resist the washing effect of moisture which accumulates in the intercoolers between the second, third or fourth stages and is carried into the cylinders.

For compressors producing 2000 psi. or more, special engineering consideration is necessary.

Electric Motors

The small amount of care which electric motors require is a tribute to the electrical industry. Motors must be ready for instant dependable starting under every set of circumstances. Many are located outside, or in inadequately heated buildings. During early fall and winter months temperature extremes are common. Oil becomes jelly-like and congealed in the bottom of oil reservoirs and oil rings cannot travel when the shaft begins rotation.

By the time the frictional heat has thinned the oil sufficiently to permit distribution, serious damage may have been done. Bearings and shafts may have become scored and abraded. Fuses are frequently burned out. This causes irritating loss of time and production.

Most present day motorists are aware of the wisdom of changing to a lighter winter motor oil to facilitate starting as the snow begins to fall and freezing weather appears. Gears are shifted only with the greatest difficulty unless winter oils of good fluidity characteristics are added. Many industrial maintenance men have not yet learned that seasonal oil changes can prevent time losses and remove the necessity for expensive repairs to equipment which is exposed to the weather.

Conversely, many electric motors are located over electric annealing ovens, or in poorly venti-

lated positions where ambient temperatures are high. In such motors, if improper greases are used, or if application is too frequent, the churned, soup-like semi-fluid grease leaks out of bearing housings into the armature and fields. This causes contamination of the commutator and brushes, and permits arcing at these points. The high resulting temperatures melt the solder out of the commutator ring and the motor is destroyed.

If this result is not developed, the oil and grease cause gradual deterioration of field and armature insulating materials, and also large quantities of dirt and dust accumulate. This interferes with ventilation and air circulation through the motor, overheating and its attendant evils.

In ceramic plants, cement plants, foundries, mines, smelters, mills, etc., where electric motors operate in dirty, dusty surroundings, the lubricant should be changed at frequent intervals. A light bodied oil which permits settling out of dirt and abrasives is more advantageous than a heavier oil which might normally be recommended. Frequent cleaning of oil reservoirs of the ring oiled type of motor prevents accumulation of dirt and sludge which would be responsible for sluggish ring action, or even stuck oil rings.

When electric motors of the ball-bearing type are equipped with pressure gun fittings, excess lubricant is all too frequently forced into the housings. This breaks bearing seals and allows leakage into the motor proper. In most cases it is desirable to remove the grease fittings and service the motor only at monthly or even semi-annual periods, depending on the severity of the service. Any high quality ball bearing grease can reasonably be expected to last for 6 mo. without replenishment, if bearings are correctly packed and operation is normal.

The dependability and reliability of electric motors is in most cases taken for granted. They must be ready for instant operation in every conceivable service; overload, shock load; low temperatures, high temperatures, dirty surroundings, acid fumes, water and moisture from industrial processes. It is a marvel that they operate with so little care and maintenance. A few simple rules that pay big dividends are as follows:

1. Change to a light winter oil of good fluidity characteristics in motors which operate in the open or in poorly heated buildings.

2. With ring oiled bearings where ambient temperatures are high, use a heavier bodied oil than is normally recommended.

3. With ball-bearing types of motors use a high melting point grease, which will stand constant churning without loss of consistency.

4. Do not overfill oil reservoirs.

5. Do not over-lubricate ball bearings or break bearing seals.

6. Change oil often when motors operate in dirty, dusty surroundings and use a light bodied oil.

7. Automatic oiling devices are available which control proper oil levels and which are easily visual.

Lubricants for Electric Motors

A suitable oil for electric motors with ring oiled bearings, producing from 5 to 25 hp., operating in either constant or intermittent service, is described below:

a. Viscosity at 100 deg. F.—140 to 170 sec.; at 210 deg. F.—40 to 50 sec.
b. Gravity—24 to 30
c. Flash—360 to 410 deg. F.
d. Fire—380 to 450 deg. F.
e. Pour Point—5 to 15 deg. F.
f. Color—1 to 3
g. Carbon Content—0.01 to 0.05
h. Neutralization Number—0.0 to 0.005
i. Additive—Optional

For electric motors equipped with ring oiled bearings ranging in size from 25 to 50 hp., in average service, use the oil recommended for air compressors operating at pressures up to 150 psi.

For electric motors equipped with ball bearings which are either grease packed or supplied through pressure fittings, a grease should be used which will retain sufficient consistency at the operating temperature to resist leakage, and which will also resist consistency change following "working" by the rapidly moving balls.

A new process of grease manufacture has recently been patented which provides for complete dehydration of the soap stock. The finished grease is a distinct improvement for electric motor lubrication, since it will function without undue loss of consistency for temperatures approximating 480 deg. F.

An American Engineer Looks At Europe

This brief consideration of Europe and post war conditions by Mr. Powel, brings out two points of particular significance. First, we must greatly improve our labor relations if we are to survive as a democracy; and second, any plan for stable economy must take into account a more liberal attitude towards other countries in our foreign commerce with them

By C. A. POWEL
Manager, Headquarters Engineering,
Westinghouse Elec. & Mfg. Co.

SEVERAL YEARS ago on my return from Europe, where I was visiting in connection with the Plenary Meeting of the International Electrotechnical Commission in Torquay, England, I wrote an article under this title, "An American Engineer Looks at Europe". What we looked at then was very different from what we are looking at today, when the whole continent is torn apart by war and hate. It is not a pretty picture, but nevertheless, I think it is wise, even now, to watch developments over there as well as we can, because by this time it must be clear to everyone that Western civilization is a single entity. Thoughts and trends developed in Europe today come to America tomorrow. Ideas and ideals developed in America today reach Europe tomorrow. That was always so; only the tempo of the interchange of ideas is different. High speed travel and radio have now put Europe and America a few hours apart instead of several

weeks. Even the American Revolution was in fact a world revolution which started in America. I am not sure that England did not profit more quickly from that revolution than the States did. The upward trend of social betterment for the working classes in England takes a decidedly steeper slope immediately following the American Revolution. The period from 1800 to 1824 was marked with strikes and riots by the working classes to improve their lot until in 1824 they succeeded in having the so-called Combination Laws repealed.

Price Control in the 14th Century

It may be profitable to take a look at the start of unionism in view of the labor situation in this country. Labor laws go back in England for hundreds of years. Around 1345 to 1348 the greatest plague of historic times struck Europe, originating apparently in Asia Minor and travelling west to reach England in 1348. The historian Hecker estimates from the records available that 25 million people died, including nearly half of the population of England. The result was a serious shortage of laborers and wages went sky high, the increase in some cases being as much as 50 per cent. In 1351 to cope with this increase there was passed a law known as the Statute of Laborers to fix wages and hours of labor at the pre-plague level. There was a section in the law entitled "Victuals shall be sold at reasonable prices." In other words, it was an attempt to keep down the cost of living. The workers did not accept this law without protest. One Walter Halderly in Suffolk was arrested because, I quote, "he took 8 pence a day at reaping time and at the same time made various congregations of laborers and counseled them not to take less than 8 pence." They put him in jail. But he had some success and after a time a union, or as they were originally called, a combination, was formed known as the Great Society, which forced some concessions from the King.

CHARLES ALFRED POWEL, long noted as a diagnostician of power plant problems, especially for the heavy industries, is manager of the Headquarters Engineering Department of the Westinghouse Elec. & Mfg. Co. He has supervision over the Industry Engineering Department, the Engineering Laboratories and Standards Department, the Foreign Engineering Department and the Engineering Association Activities.

Fourteen years of electrical engineering experience in Europe and Asia and 22 yr. with Westinghouse prepared Mr. Powel for the task of co-ordinating the many engineering activities of the Westinghouse Company.

Born in Rouen, France, on July 30, 1884, the son of Welsh parents, he was educated in London, England, and at the Institute of Technology of Canton, Berne, Switzerland, where he was graduated in 1905.

The son of a British manufacturing engineer whose business interests for many years were centered in France, Mr. Powel spoke several European languages fluently even in childhood. Upon graduation from the Institute of Technology, he joined the internationally-known Swiss electrical firm of Brown Boveri & Co. in Baden, Switzerland, and was assigned to the firm's English section, beginning immediately to concentrate on the power problems of the heavy industries.

In 1911 he was appointed resident engineer in Kobe, Japan, for Brown Boveri & Co., remaining in the Orient until 1915 when the World War seriously interfered with international trade. Returning then to England, Mr. Powel joined the civil branch of the Ordnance Department.

A year later a war mission brought him to the United States for what was to become permanent residence and eventual American citizenship. This service in the First World War also gave him valuable experience for the assignment of manager of the Headquarters Engineering Departments at Westinghouse at a time when this vital American industry is producing many millions of dollars worth of materials for the national defense.

Honorably discharged from the British Service in 1919, he joined the General Engineering Dept. of the Westinghouse Company at the East Pittsburgh, Pa., Plant and 2 yr. later went to France as a consulting engineer for Westinghouse.

In 1932 Mr. Powel was made manager of the Central Station Engineering Department at East Pittsburgh and 6 yr. later was chosen as manager of the then newly formed Industry Engineering Department, which serves as a sort of clearing house, providing engineers in various fields with the most recent engineering developments affecting their various industries.

Active in the Pittsburgh Section of the American Institute of Electrical Engineers, Mr. Powel served as chairman of the section and a 4-yr. term as Director of the institute. In 1939 he was chairman of the special committee named to establish the Institute's Fortescue Fellowship for postgraduate work in electrical engineering. He is chairman of the committee that administers the fellowship and also chairman of two coordinating committees of the Institute's Standards Commitee.

Mr. Powel is chairman of the National Electrical Manufacturers Association Committees on Insulation Coordination and Preferred Voltage Ratings and is also technical advisor to the United States National Committees of the International Electrotechnical Commission on High Voltage Insulators and Insulation Coordination. He was named technical advisor to these committees, which set international standards for the industry, by the American Standards Association. He attended the plenary meetings of the I.E.C. in England in 1938.

In 1562 labor succeeded in getting through Parliament a Statute of Artificers to curb employers who were chiselling by paying only apprentices' wages. The law forbade a man to employ more than three apprentices for each journeyman on his payroll. But it must be admitted that most of the early laws were passed with the object of restricting labor and not of helping them. Despite this, combinations of workmen were formed and we find them among silk weavers, basket makers, printers, shipwrights, shoemakers, carpenters, and bricklayers—names which are still familiar to us today. By strikes and by political means, these combinations kept on fighting for the betterment of conditions for the laboring classes, and finally, thanks principally to the efforts of a member of Parliament named Joseph Hume, they succeeded in 1824 in having a Royal Commission formed to investigate the whole situation. This resulted in 1825 in the repeal of all previous statutes against combinations of workmen enacted during the preceding five centuries, and a few years later in the creation of the Grand National Consolidated Trade Union which was probably the first of the Trade Unions as we know them today. This huge combination of trades at its zenith comprised a million workers, but due to internal strife, strikes, and lockouts, it finally broke up and in the middle of the century a fresh start was made with a number of smaller unions.

This slow growth, I think, explains the great difference between trade unionism in England and in other countries. Because of the spirit of compromise which seems to pervade all English politics, unionism has gone through an evolution instead of a socialistic revolution. It explains also why one finds in England craft unions, industrial unions, occupational unions (what we call company unions) and general labor unions (casual laborers that don't fit into craft and industrial unions) working side by side. They apparently have found a solution to jurisdictional disputes by permitting a relatively large number of unions. All these unions have governing bodies, such as the Trade Union Council, which are very influential in the Labor Party. Collective bargaining is general and in some trades also the closed shop, but the worker is better protected against the union. If a man is turned out of a union

he can sue in the courts for reinstatement and damages.

Strikes in England

In view of what has happened in recent months in this country, it is interesting to note that a strike is illegal in England,

(a) If it has any object other than the furtherance of a trade dispute within the trade in which the strikers are engaged.

(b) If it is designed to coerce the government by inflicting hardship on the community.

I have given you this picture of trade unions for two reasons—first, I hoped you would find it interesting, as I did, and secondly, because I think it is tremendously important for all of us to remember that the relationship between capital and labor must be based on compromise. The first requirement to bring this about is that labor unions must be made to assume the same financial and social responsibilities as is expected of any business corporation. We must not forget that it was the excesses of labor groups reacting against an autocratic aristocracy that brought Bolshevism to Russia, nor that it was a violent reaction against the equally violent excesses of labor that brought Fascism and Nazism to Italy and Germany. These are real dangers that we must guard against.

In Germany there are, of course, no unions. Trade unionism is possible only under a democratic form of government. One of the first things Hitler did was to get rid of all unions, which was necessary if Germany was to survive. There is only one source of wealth and that is production —you produce from your economic resources as do to a large extent the U.S.A. and the British Empire, or if you don't have any economic resources, as in the case in Germany, you produce by the sweat of your brow—work, work, and everlasting work. Hitler with all his faults recognized this and he put Germany to work—the right to work became the duty to work. Unemployment which rose to 6,000,000 workers in 1933 was non-existent in 1937. The plant they had to work with was one of the finest in the world, built up largely with foreign credits and investments, which were written off with a single stroke of the pen, and in that plant they built excellent equipment.

After the War, competition will be much keener and more world-wide, and it may be of value, therefore, to take a look at the prospects of maintaining our position in the export field.

The Economic Balance Before First World War

Before the first World War, thanks principally to the free trade and banking policy of England, a nice economic balance was maintained throughout the world. The Empire sold raw materials and in exchange bought finished products from industrial countries, England providing the capital. The U.S.A. sold raw materials abroad and at the same time developed and kept a tremendous domestic market by suitable tariffs. The domestic market was so great that we were not vitally interested in the sale of finished products to foreign markets, and neutral markets for such products were left pretty much to England and Germany. The War upset all this nice balance. The old international financial setup that revolved around the pound sterling collapsed and every country, including the new ones, like Czechoslovakia, Poland, and Hungary, started organizing domestic industries and putting up trade barriers in an attempt to make themselves self-sufficient. To do this they borrowed abroad and mostly from this country which was the only one left with any spare cash.

It has been said frequently that with better statesmanship and wiser tariff laws we could have taken over the role of international banker previously played by England and maintained some sort of economic balance in the world. This may be true. I am no banking expert, but to me it seems doubtful because while we might have imported some articles which have been kept out by high tariffs and thus helped to balance accounts to some extent, the fact remains that our export of finished articles has kept up better than our exports of raw materials. In 1925 our export of raw materials and farm products equalled very closely our export of finished products, both being around $1,800,000,000. By 1938 the export of raw materials and farm products had dropped a billion, but our export of finished products had dropped only $300,000. This is a clear indication that we are turning out finished articles which appeal to the outside world and that when they had to stop buying something from us because of inability to pay, it was the raw materials that they purchased elswhere and not our finished products. Even so, the balance of trade was still top-heavy and in 1938 our sale of finished and semi-finished articles exceeded our purchases abroad by a billion dollars.

Post War Prospects

In view of this situation, what are the prospects of setting up a satisfactory economic balance after the war? We have read recently a good deal about plans for maintaining our internal economy after the war. Fundamentally they are all based on maintaining our production at war level. In other words, if our annual income with full employment is $110,000,000,000 during the war, we should maintain it after the war at essentially the same level using public expenditure to whatever extent necessary. I have seen nothing in these plans which takes into account our foreign trade, but as Sumner Welles recently stated:

"Every citizen of the United States, while perhaps individually only indirectly concerned, is nevertheless vitally affected by our foreign commerce. The prosperity of our country, the level of employment, the best interests of labor and of the consumer, and the living standards of our people depend to a very great extent upon the condition of our foreign trade."

President Roosevelt and Churchill have stated in their so-called Atlantic Charter that all nations must have access to sources of raw materials on equal terms. This is unquestionably a fundamental requirement of balanced economy, but in view of the top-heavy situation in finished products previously commented on, it seems to me we should go further and make available to appropriate concerns abroad our engineering skill. Our large corporations can afford to maintain research departments that many smaller industrials abroad cannot, but they are willing to pay well for information they can use. In the last 15 yr. or so the sale of design specifications, patents, and manufacturing information has

(Continued on Page 110)

Clearing

Fig. 1. (Left) Air view of WPA Camp No. 40. Taken from an elevation of 500 ft. this photograph shows a typical camp layout. This camp accommodated 275 men

Fig. 2. (Below) Air view of the junction of the Wateree and Congaree Rivers. The wooded area below the junction was cleared under this project

IN THE LOWLANDS of South Carolina where the powerful Santee River once flowed through a great swampland midway between Columbia, the Capital, and Charleston, there has been completed in the past 2 yr. the greatest clearing operation in the country.

An integral and essential part of the Santee-Cooper Hydroelectric and Navigation Development, this huge clearing operation has prepared more than 103,000 acres of swamp and forest land for the basins that form the twin reservoirs of the power project.

Sponsored by the South Carolina Public Service Authority, this job called for the organization and direction of a huge labor force to combat the swamp and jungle-like growth of the lowland areas. The Work Projects Administration was given the job and it was carried to completion in a little more than 2 yr. More than 9000 men were employed on the clearing alone at the peak of operations.

Conceived in peace time to promote the industrial development of this section of the South, the Santee-Cooper project is now an important asset in our War effort. Through this vast undertaking—one of the few hydroelectric power developments constructed at such a low elevation—facilities have been created for the generation of a huge block of electric power and a navigable waterway for large boats from Charleston into the interior of the state.

The fact that the waters of the Santee River could be impounded by an 8-mi. dam and dikes thrown across the eastern end of the Santee swamp, thus diverting the waters of the Santee into the Pinopolis reservoir and thence through the power production plant at the Pinopolis Dam, made the development possible. With the Pinopolis Dam two large reservoir lakes, connected by a 7-mi. canal, 200 ft. wide, were formed, creating a "head" of water sufficient for power and navigation.

The lake made by the dam across the Santee River extends approximately 50 mi. back toward the center of the state in a westerly direction. The storage reservoir thus created is more than 100,000 acres, and the two reservoirs together cover about 164,000 acres. Santee Lake covers about 155 sq. mi. with a maximum depth of 35 ft. and Pinopolis Lake about 95 sq. mi. with a maximum depth of 75 ft.

With its modern manifestations of power and navigation the Santee-Cooper project has brought to life again the path of the old Santee Canal, the historic waterway that was dug between the Santee and the Cooper Rivers at the start of the Nineteenth Century and flourished for 50 yr. on the rice and indigo trade between Charleston and the interior. The Santee-Cooper project hinges on the same topographical peculiarity that made the canal possible—the difference of 45 ft. in elevation between the Santee, running southeast across the state, and the headwaters of the Cooper north of Charleston. This difference in elevation, plus 30 ft. that the two dams have added, provides a "head" of 75 ft. for power.

To build the dams, the thousands of feet of dikes and the miles of canal required engineering skill and resourcefulness of a high order. But the story of WPA's herculean task of clearing the swamp-forest, of men working hip deep in swamp water day after day, devising special equipment to suit the terrain and using ax and saw where no other equipment was possible,

The Santee-Cooper

Details and photographs of the greatest clearing project ever undertaken in this country. The clearing of land to be impounded is an aspect of a hydroelectric project to which the layman or even the average engineer usually gives little thought, yet, as shown by this description, this part of the work often involves problems in many ways more difficult of solution than those encountered in the design and construction of the dams and power plants. The cost of this particular clearing project was over $10,000,000

meanwhile living almost in home-like safety in the middle of the malarial swamp, is a testament to the determination and endurance of this country's man power and WPA's ability to organize efficiently such man power for large-scale field and engineering operations. Expenditures by the WPA for the clearing project totaled over $10,000,000, of which more than $9,000,000 was paid in wages alone.

The land selected for the lake beds was practically valueless. At one time portions of it had been rice fields, but in recent years only a small part had any agricultural value. Some 700 families, mostly Negro, made the swamplands their home. These were moved to higher grounds, along with their possessions.

The swamp was a dense jungle of hardwood trees, undergrown with thick and abundant vegetation. Only a small part had dry footing. Much of the remainder was covered by water or dotted with sloughs and ponds, which made the ground permanently unstable.

Such was the terrain faced by WPA when clearing was begun in the fall of 1939. A force of carpenters started the first camp early in the fall, to house themselves, electricians, plumbers and other artisans who were to be busy during the clearing operation, erecting, dismantling and moving the camps from one location to another, as the clearing progressed.

The first clearing force came to the area in November, 1939. The workers had been selected from every county in South Carolina, and were a picked group. Before being assigned to the project they underwent a thorough physical examination in their own county. Those who passed were transported in project trucks to the work area, the convoys piling up a remarkable record during the period of transporting 32,000 men an aggregate distance of 700,000 mi. without a major accident.

Each camp consisted of about 90 buildings, designed to accommodate from 275 to 300 men, and included a kitchen, mess hall, first aid station, administrative quarters, laundry, blacksmith shop, power house, warehouses, recreation hall, bathhouses, garages, canteen and storage tanks. The bunk houses, 8 by 16 ft., accommodated four men each.

Buildings were constructed in panels, and assembled at the camp sites. At the end of operations in an area, they were dismantled and transported an average distance of 50 mi. and reassembled.

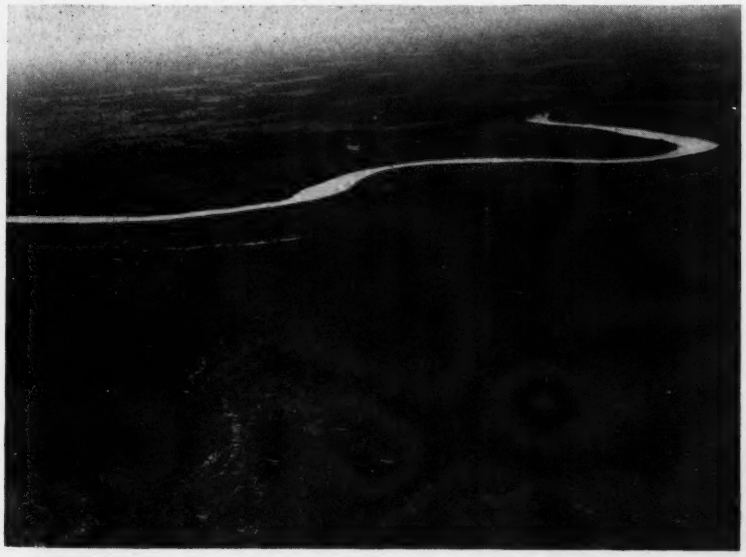

Fig. 3. (Above) Looking across Santee Swamp from Camp No. 29 showing a portion of the area cleared from this camp

Fig. 4. (Right) View of the clearing done from Camp No. 22. Note the water standing all over this swamp and the log piles ready for burning, at the right of this picture

Fig. 5. (Above) View of the portion of the clearing done. Note the great number of logs which have been cut, delimbed and wired securely from both ends to stumps

Fig. 6. (Right) A photograph of the old Black Oak Lock on the old Santee Canal built early in the Nineteenth Century

Fig. 7. (Right) Logs and underbrush being piled and burned in one of the clearing areas. At right is a bridge—one of 90 such bridges—built so that workers could reach remote areas

Fig. 8. (Below) View of portion of Pinopolis Basin showing Camp No. 8 in foreground. This shows a portion of the cleared area being flooded

A total of 31 camps and 45 work locations were used during the life of the project. As the men cut their way into the swamp-forest, roads and bridges became a necessity for the transport of supplies and equipment. One hundred and eighty miles of road were built by WPA, and 90 bridges, some up to 1000 ft. in length, were constructed.

Specifications provided that the Pinopolis reservoir be cleared entirely of trees, with undergrowth, brush and slash piled and burned. In the Santee reservoir basin specifications called for clearing 1 mi. off shore line in the direction of the river, and in elevations below 67, trees should be cut and delimbed, with all brush, limbs and slash piled and burned, and the remaining logs securely wired to stumps to hold them to the bottom of the lake until they became so waterlogged they could not rise.

Total acreage involved in the clearing operation was 103,313, of which 45,307 acres were in the Pinopolis area and 58,006 in Santee. During the peak of operations in the summers of '40 and '41, the work progressed at the rate of 4000 to 5000 acres per month.

The Santee River followed the

southern edge of the Santee reservoir and it was necessary that the work camps be located above the flow line on bluffs because of the periodic overflow of this meandering stream. Thus it was necessary to transport men across the river, to reach their work, in the mornings and back to the camps in the late afternoons, and in some instances up and down the stream. This necessity brought into being the project "navy," a fleet of five converted tugboats licensed for capacities of 170 persons each; a 50-t. lighter used in transporting mule teams and equipment on the river, and about 30 small boats used in general clearing and floatage removal. The project also operated 185 pieces of automotive equipment.

Due to the low-lying ground involved in the clearing, little heavy land-clearing machinery could be brought into use. Where footing was good, mules were used to skid and deck the logs. In other places tractor-mounted cranes were operated. But in many places neither could be used and it became necessary to build and adapt special machinery and equipment to meet the occasion.

Heavy pontoon flatboats were built, 10 ft. wide and 16 ft. long. On these were mounted single and double drum skidders. In deep water these devices were used as boats; in shallow water as sleds. With the desired machinery mounted on them, a long cable was attached to a tree left standing for the purpose, the drums set in motion and the boat drawn to the desired spot.

The project owned and operated a number of Link-Belt Model TS 40 Speeder cranes mounted on Caterpillar D-6 tractors. These cranes have a 28-ft. boom and a 270-deg. swing.

Every effort was made to safeguard the health of the men. In addition to the pre-work physical examination, medical services for each camp were provided by a staff of full-time physicians stationed at strategically located centers. Each camp was visited daily by a physician. Six ambulances were available in designated central camps to carry sick or injured men to camp or outside hospitals.

The health record of the men was unusually good. Beyond reach of a central water supply, each camp had its own deep 6-in. wells, the water being tested periodically by the state department of health.

The food was uniformly good. Ice and milk were delivered every day, meat and fresh produce three times a week. Staples came in every 10 days. For their food, lodging, medical and dental care the men paid 60 ct. per day, or a total of about $18 per calendar month.

The peak of operations was reached in March, 1941. At that time there were more than 9000 WPA workers in the swamp, operating clearing equipment, swinging axes, sawing down the great trees, piling and burning the slash.

Approximately 4000 men were engaged in cleaning up the last work after January 1, 1942. The lower levels had filled with Santee's water; power was flowing and boats were moving. The lock at Pinopolis Dam, with its lift of 75 ft., is said to be the largest single lock unit in the United States. It has a chamber 108 ft. long and 60 ft. wide. Walls of the chamber are part of the dam itself, 100 ft. high, constructed of concrete and steel, with steel miter gates at the end.

Based on water records taken over a period, engineers expect the dam and power installation to be capable of adding 700,000,000 kw-hr. of electric power to South Carolina's annual output. Five turbines of 40,000 hp. each, and one of 13,000 hp., drive 34,000-kw., 3-phase alternators, generating at 13,800 v., and a smaller generator of 11,300 kw. capacity. Transformers will step up the voltage to 66,000 v. for delivery to transmission lines.

TWO MILLION DOCUMENTS RECORDED ON MICROFILM

THROUGH the use of microfilming equipment a story of the electrical industry's growth since the early 1880's is being transferred from two million sheets of old Irish linen and drawing paper to movie film at the Westinghouse East Pittsburgh works. An acre of storage space will be cleared for productive use and a more efficient record system set up by reducing the size of tons of permanent records. When recorded on film, documents which now occupy more than an acre in floor space can be stored in a vault about 10 feet square.

More than two million of these documents will be photographed during this 2-year project. To be put on 16 or 35 mm. movie film, depending on size, are records ranging from 5 in. cards to 5 ft. drawings. Records of typing paper size or smaller are fed into an automatic camera machine which snaps the pictures at an average rate of 35 per min. Larger ledger sheets, engineering drawings and tracings are photographed by a 35 mm. camera suspended above a table. The distance between camera and table is automatically adjusted to the proper focus.

Old shop orders, sketches, drawings and charts which have accumulated from the time the company was organized 56 yr. ago are all being photographed. Plans and sketches of the first alternating current equipment produced in America in 1885, the early generators that harnessed Niagara Falls in 1896, the first electrical apparatus to drive ships in 1912 are being taken from the archives.

Filing Cabinets Eliminated

The savings in sheet steel required for such cabinets marks another step in the company's effort to conserve important metals for the war effort. Each year 25 steel filing cabinets have been installed for the tracings of engineering drawings alone. These and similar bulky cabinets now occupy an estimated 50,000 sq. ft. of floor area. Most of the cabinets can be eliminated and this space put to more productive use.

Previously, two steel filing cabinets were required to hold 2700 shop orders. When recorded on 16 mm. film, these same orders will fill just one film roll of 100 ft. which fits into a box about as large as two cigaret packages. One roll of 35 mm. film will record more than 800 drawings the size of newspaper sheets. To assure safekeeping for these vital industrial records, a master file of the microfilms will be stored in a fireproof, burglarproof vault. The film rolls will be placed in a series of asbestos compartments behind double doors which are locked by combination.

Photographic Blue Prints

Three other complete files will be located elsewhere in the East Pittsburgh works, however, for quick reference use, a special projector or reader enables engineers to see the enlarged picture on a screen and photographic enlargements can be printed if working copies are needed for use as blue prints.

Microfilming has been used at the Westinghouse Sharon works for about a year. The first 80,000 shop orders filmed were taken out of 275 steel cabinet drawers and put on film that required just three-quarters of one drawer.

THE CONSTRUCTION OF ALINEMENT CHARTS

BY W. C. SEALEY
Engineer in Charge, Transformer Design
Allis-Chalmers Manufacturing Co.

Many articles and books have been written on the construction of alinement charts, but, it seems, there is always room for another treatment of the subject. In this consideration of the subject, Mr. Sealey sets forth in a very simple way, the fundamental principles involved in the construction of these useful engineering devices. By means of a series of ten rules he makes it possible to apply these principles and to enable anyone with a little effort to transform ordinary equations into usable alinement charts. Specific examples are given to show in detail how the charts are constructed. This article describes the construction of simple charts involving only straight lines. In an article to be presented subsequently more complex charts will be discussed

GRAPHICAL DEVICES for the solution of engineering problems are in common use because they save time and reduce errors. Graphical solutions are possible for a wide variety of applications. When only two variables are involved, tables or curves on coordinate paper are in most general use. When the application involves three variables, the form of graphical device known as an alinement chart is often used. When properly constructed, such charts correctly represent the relation between the variables. A common form of alinement chart has three scales, one for each variable. If a straight line is drawn through the points representing the values for two of the variables, the value of the third variable is indicated at the intersection of the straight line with the third scale.

In the simplest form of chart, the scales are marked on three parallel straight lines, such as shown in Fig. 2. This form of chart can be constructed whenever the relation between three variables is an equation in which no term contains more than one variable. An example of such an equation is:

$$(1)\quad 4R^2 + R + 3S + 2T = 6$$

In this equation the variables are R, S, and T and no term contains more than one variable. It is sometimes necessary to change the form of the original equation by applying algebraic rules to reduce it to this form.

If the above equation had been written:

$$4R + 1 + 3\frac{S}{R} + 2\frac{T}{R} = \frac{6}{R}$$

it could not be used to construct a chart for the relations between R, S, and T without first changing its form since the third and fourth terms contain two variables. Multiplying both sides by R reduces the equation to the form $4R^2 + R + 3S + 2T = 6$, which is suitable for chart construction.

In order to be in a suitable final form for chart plotting, the equation should be reduced to a specific form. When in this form, the equation is expressed as the "sum of three quantities each containing only one variable equals zero". In order to be in the specific form there is the additional requirement that "the sum of the coefficients of the three quantities must equal zero". The last sentence can also be expressed: "The coefficient of the second term must be equal to the negative of the sum of the coefficients of the first and third terms".

Equations containing three variables in which no term contains more than one variable can always be reduced to the specified form by simple algebraic rules.

For example the equation previously discussed, $4R^2 + R + 3S + 2T = 6$, can be written as: $1(4R^2 + R) + 1(3S - 6) + 2T = 0$, by transposing the grouping terms. Inspection shows that it satisfies the first rule "The sum of three quantities each containing only one variable equals zero".

The sum of the coefficients is equal to $1 + 1 + 2 = 4$. The second rule "The sum of the coefficients of the three quantities must equal zero" is not satisfied and some changes must be made to meet this requirement.

Using the alternate form of this second rule "The coefficient of the second term must be equal to the negative of the sum of the coefficients of the first and third terms", the negative of the sum of the coefficients of the first and third terms is equal to $-(1 + 2) = -3$.

If the coefficient of the second term is multiplied by -3 and the variable portion of the second term is divided by the same quantity, the equation becomes: $1(4R^2 + R) - 3(-S + 2) + 2T = 0$. In this form both rules are satisfied and the equation is the specified form for chart plotting.

It can be proved that an alinement chart, constructed for such an equation according to the following procedure, will correctly represent the equation.

Procedure

Rectangular coordinates with axes X and Y as shown in Fig. 1 are used for plotting. X is the horizontal axis; Y is the vertical axis. x and y are distances parallel to the X and Y axes, respectively. Values of y are marked on the

vertical scale at the left of Fig. 1. Values of x are marked on the horizontal scale at the bottom of this figure.

The scale of R would be plotted on a vertical straight line at X = "the negative of the coefficient of the third term", in this case 2 units to the left of the Y axis; values of $y = (4R^2 + R)$ would be plotted on this line and the points would be numbered with the corresponding values of R.

The scale of S would be the Y axis, values of $y = (-S + 2)$ would be plotted on this line, and the points would be numbered with corresponding values of S.

The scale of T would be a straight line at X = "the coefficient of the first term", in this case one unit to the right of the Y axis; values of $y = 2T$ would be plotted on this line and numbered with the corresponding values of T.

The example illustrates the general principles which apply. In practice, refinements are introduced solely in order to obtain the desired length and location of the scales.

The following specific rules have reduced these refinements to definite form for convenience in construction in actual practice. By following these rules in the order given, accurate charts can be readily constructed as shown in the accompanying example.

Rules for Constructing a Simple Alinement Chart

The following rules apply to equations which can be written so that no term contains more than one variable. The scales of the chart will be on three parallel straight lines.

1. The equation is written in its original form.

2. The equation is changed to a form so that the sum of three terms each containing only one variable equals zero and with the same sign for the coefficients of the first and third terms.

3. The numerical values of the variable part of the first and third terms (the part not included in the coefficients) should be calculated for the extreme values of the variables. The length of the scale for each term is the difference between the extreme values of the variable part of that term.

4. The same scale length may be obtained for the first and third terms by multiplying the variable part of the third term of the equation by a suitable factor and dividing the coefficient of the third term by the same number. This factor is equal to the original scale length for Term No. 1 divided by the original scale length for Term No. 3. (The original scale lengths are calculated in accordance with paragraph 3.)

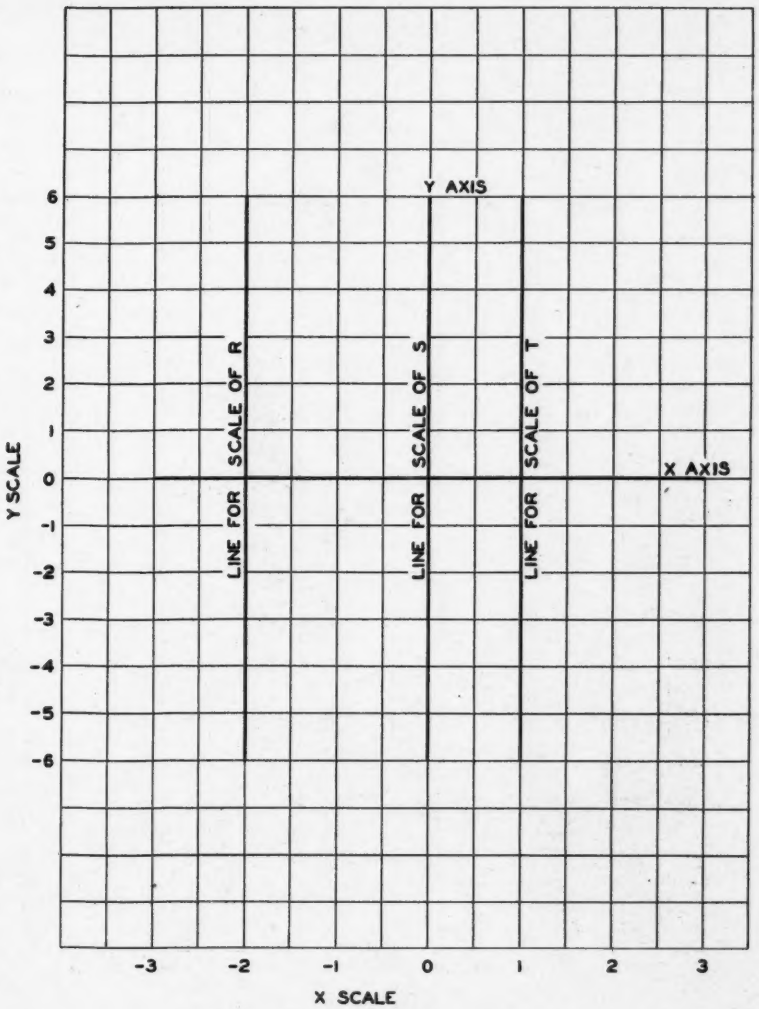

Fig. 1. Scales for plotting alinement charts

5. The outer scales will be located the same distance from the X axis if a suitable number is added to the third term and subtracted from the first term of the equation. This suitable number is equal to: (the difference between the lowest numerical value of the variable part of Term No. 1 and the lowest numerical value of the variable part of Term No. 3) X (the product of the coefficients of these terms) + (the sum of the coefficients of these terms).

NOTE: The procedures outlined in paragraphs 4 and 5 are refinements which produce the best and most accurate chart proportions. However, they may be omitted without affecting the correctness of the resulting chart.

6. If the coefficient of the second term of the equation is multiplied by (the sum of the coefficients of the first and third terms) ÷ (the negative of the coefficient of the second term) and if the variable portion of the second term is divided by the same number, the equation will be in its correct form for plotting. (The coefficient of the second term will be equal to the negative of the sum of the coefficients of the first and third terms.)

7. Numerical values of the variable portion of each term are calculated and tabulated for each variable for the range desired. These are the values to be plotted on the Y axis for each variable, respectively.

8. The first term scale will be

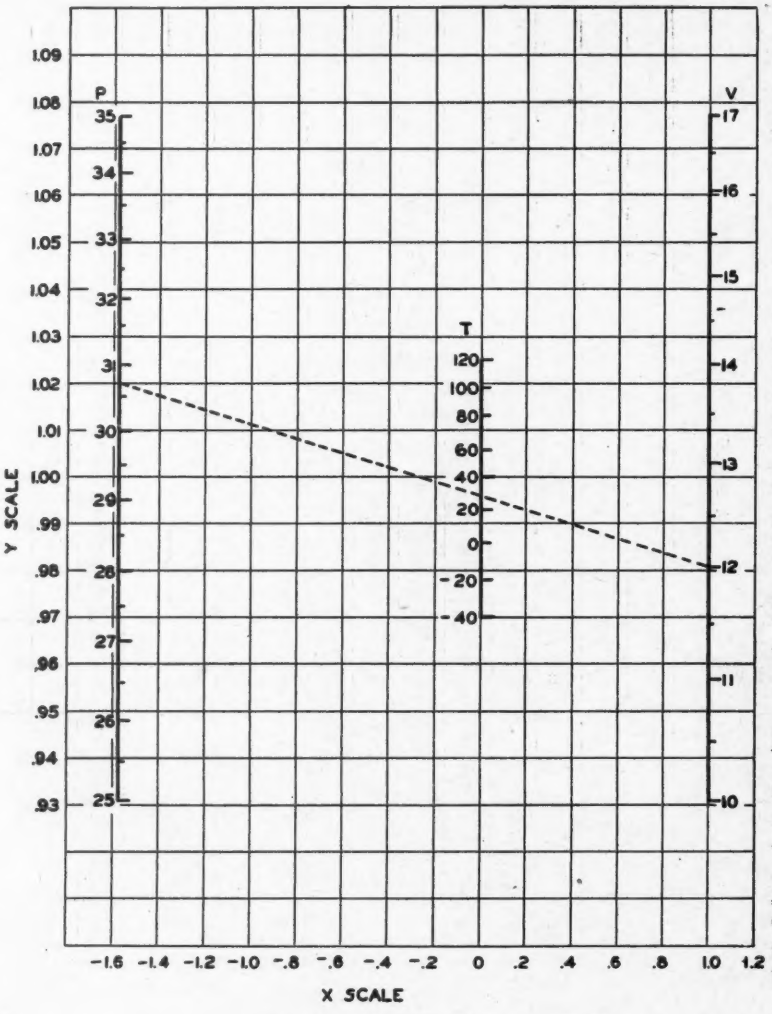

Fig. 2. A simple alinement chart

located at x = the negative of the coefficient of the third term. The second term scale will be located at x = 0; the third term scale will be located at x = the coefficient of the first term.

9. From an inspection of the values in paragraphs 7 and 8, a suitable scale for x and a suitable scale for y is chosen.

10. The numerical values tabulated in paragraph 7 are plotted on the respective vertical lines and the plotted points are numbered with the corresponding values of the variable for each scale. Intermediate points are determined graphically or by calculation.

An example follows in which the steps are numbered corresponding to the numbers of the rules.

EXAMPLE: Required to construct an alinement chart for the equation:

$$1.\ (2)\ \frac{PV}{(T+460)} = 0.755$$

P = Absolute pressure in inches of mercury which is to be plotted for values from 25 to 35 in. of mercury.

V = Volume of 1 lb. of dry air in cu. ft. which is to be plotted for values from 10 to 17 cu. ft.

T = Temperature of air — deg. F. which is to be plotted for values from —40 to 120 deg. F.

2. To reduce the equation to the specified form, the log of each side of the equation is taken: log P + log V — log (T + 460) = log 0.755. The equation is rewritten as follows: log P — log 0.755 (T + 460) + log V = 0.

3. Extreme values of y, (the variable part of each term) for the first and third terms of the equation are calculated and tabulated below:

For the first term, the variable part = log P

For the third term, the variable part = log V

P	Y = log P
25	1.3979
35	1.5441
Scale length	.1462

V	Y = log V
10	1.000
17	1.2304
Scale length	.2304

4. The Factor for adjusting the scale lengths is equal to:

$$\frac{\text{Scale length No. 1}}{\text{Scale length No. 3}} = \frac{0.1462}{0.2304} = 0.635$$

This factor is introduced into the third term according to rule 4 so that the equation becomes:

$$\log P - \log (0.755T + 347) + \frac{1}{0.635} + \frac{1}{0.635}(0.635 \log V) = 0$$

5. The number to be added to the third term and subtracted from the first term of the equation is calculated in accordance with rule 5. The lowest numerical value of the variable part of term No. 1 is equal to log 25 = 1.398. The lowest numerical value of the variable part of term No. 3 is equal to 0.635 log 10 = .635.

(Continued on Page 110)

Table Showing Values of Y

y = log P — 0.467		y = 0.388 log (0.755T + 347)		(y = (0.635 log V + 0.296)	
P	y	T	y	V	y
25	0.931	—40	0.970	10	0.931
26	0.948	—20	0.978	11	0.957
27	0.965	0	0.986	12	0.981
28	0.980	20	0.993	13	1.003
29	0.995	40	1.000	14	1.024
30	1.010	60	1.006	15	1.043
31	1.024	80	1.013	16	1.061
32	1.038	100	1.019	17	1.077
33	1.051	120	1.025		
34	1.065				
35	1.077				

The PRACTICAL ENGINEER and ELECTRICIAN

RICHARD H. MORRIS, EDITOR

MORE NECK STEPPING

DURING the past month practically half the letters coming in made some reference to the gentle art of sticking one's neck out gracefully. Some admit they are leathernecks so thoroughly calloused that being stepped on no longer hurts, others admit their necks are still tender but recognize that risks must be taken occasionally, and several sending in articles and answers for the first time said, "I've never looked at it that way and when I realize how much I have profited by the experience of others and how little I've given in return I feel ashamed of myself for playing turtle and pulling in my sensitive neck."

No one likes to hurt another's feelings needlessly and as editors we try to keep public "neck stepping" to a minimum by editing and making a careful selection of material published. Vast quantities of discussion never see the press but are passed on by mail. The Hatfield and McCoy scrap was child's play as compared to some of the "private feuding" for which we act as a clearing house.

This, says one correspondent, "is a mild form of escapism that offers: the chance of adding a few kopeks to the coffers; gives me something other than daily routine to be interested in; gives me some ideas I can use; makes me do some review and research that doesn't do me any harm; and sometimes impresses the Boss."

This last, that is the Boss, cannot be overlooked. Many men have written themselves a reputation and sometimes this outside recognition is of help in other ways. Not so many years ago I was the assistant in an industrial plant. The chief, an old marine man who held a chief's ticket at 24, was tops but had a few idiosyncracies. One was an implicit faith in gage readings regardless of calibration or when and how they were installed.

Half the gage readings had no meaning and we battled for 2 yr. Finally I wrote an article which was finally published as a letter, covering the better part of 2 pp. with the last few paragraphs and the signature on the third page. The magazine was delivered one morning, he read most of it aloud, underscored sentences, said he was going to have it framed and hung up over my desk. I left just before he turned the page and discovered the author. He never mentioned it again. Neither did I—but we never had another argument about gages.

Richard H. Morris

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A Section of Power Plant Engineering Devoted to PLANT OPERATION AND MAINTENANCE

Technical Publishing Company
53 West Jackson Blvd., Chicago, Ill.

Where Do YOU Stand in the Draft?

If you're a working man—and do not intend to volunteer—both you and your employer have a very definite interest in knowing where you stand in the draft and what the future may bring. Not all can be foreseen, but these comments, made by Tom P. Walker, Chairman of the Council of Electric Operating Companies, at a recent New York meeting, paint a clear picture of the present and give a glimpse of what may happen later in the war and in the post war period. In spite of what may happen, the immediate problem of current operation must be faced. This problem is trying now and will become more acute as time goes on. If you look at it that way a "prewar" family is better protection than even a "war" job, but neither these nor a present 1B classification will be effective for long

THROUGH Selective Service regulations, manpower placement laws and economic compulsion, the productive skill and labor of the nation is rapidly being sifted into four classifications: (1) the fighting forces; (2) war production; (3) support of the war effort; (4) non-essential production for civilian comfort and convenience.

This war must be won by armed fighting men finally routing the enemy, hence the Selective Service System must have the first call on the men it needs for the fighting forces.

The second classification (war production) supplies implements for the fighting man and nothing else. Only the manufacture of equipment which shoots or flies, or floats or swims qualifies for this group—ships, planes, tanks, guns and other materials directly used in the prosecution of the war.

In the third classification fall activities which support the war effort including food, clothing, shelter, health, safety, electric power, and other requisites of our daily life.

Then in the fourth group are activities which produce solely for non-essential civilian comfort and convenience.

Patriotic fervor and the operation of the Selective Service Act are maintaining a constant flow of men into the first group. High wages supported by unprecedented public spending assure almost complete satisfaction for the second group. But the filling of jobs in these two groups has been almost wholly at the expense of the activities included in groups three and four.

By and large, civilians conform cheerfully to rationed living, or at least console themselves with a minimum of complaint. It is inevitable that they and those who supply their luxuries and conveniences must suffer discomfort and even hardship. Enterprises that fall in group four and those whom they serve, therefore, must be prepared to take the rap.

Utilities in Third Group

But for the third group, which includes our industry, there is small opportunity for curtailment and the pressure for the transfer of men into groups one and two is constant and impelling. Operation of facilities which supply power to war production plants is vital.

That portion of the electric business, however, which supplies power for cooking, lighting, entertainment, and other conveniences not absolutely essential to implement the soldier at the front, can only be continued as long as it does not interfere with the main job. Any man able to fight or produce materials of war whose loss would impair only these non-vital services cannot be considered a critical employe and probably will not be allowed to stay in his present job.

Because the production, transmission and distribution of electric power is an activity which supports the war effort, the Selective Service System has advised local draft boards in their Occupational Bulletin No. 9 that there are 86 critical occupations in which qualified men must be continuously available to assure proper functioning of the industry.

Boards may not take men from these critical occupations unless others, who are qualified, can be found either in the industry itself or elsewhere to take over their jobs. Since Pearl Harbor when it has been necessary to fill ever expanding quotas for men in the armed forces, draft boards have frequently overlooked the necessity to maintain competent personnel for critical occupations in electric utilities.

The industry itself, on the other hand, has hesitated to ask deferment on necessary men to the point where finally it found it difficult to carry on necessary operations because of the loss of critical personnel. Now that critical occupations have been defined, draft boards need no longer take necessary men nor need executives be embarrassed when seeking their deferment.

The Job and Not the Service

It is important to note that it is the JOB which is critical and not the services of the particular MAN who holds it. Because a man fills a critical occupation, is no basis for his continued deferment. His job does not protect him against the draft. If he is subject to the draft, he can be deferred only as long as it takes to train or find a man to take his position.

If there is a qualified man available, then he must replace the man to be drafted. If one is not available, Selective Service Regulations contemplates that the industry will train its own replacements using women or men not likely to be drafted if at all possible.

It is the responsibility of the draft boards to allow the industry to maintain qualified personnel for critical occupations, BUT it is equally the responsibility of the industry to provide such training and replacement as will require a minimum deferment of necessary men.

There is a distinction between the classification of men in war production activities and those in activities which support the war effort in that the otherwise qualified draftee in war production is given a Class 2-B rating while those in the activities supporting the war effort are rated 2-A.

The difference in these ratings does not necessarily represent a difference in the essentiality of occupations. Under Selective Service Regulations, a Class 2-B man and a Class 2-A man are equally important to war production, and the class serves to distinguish the type of industry in which the man is engaged.

Occupations not listed in the Occupational Bulletin or not falling within descriptions of the listed job titles are not critical occupations and accordingly, draft boards are not required to consider applications for deferment of men in them, but they may do so if there are other compelling factors in the situation.

Not all payroll designations of critical jobs are included in the 86 on file with the draft board. Many men actually in critical occupations will not find an exact counterpart of their payroll designation in this list. There is on file with the National Headquarters of the Selective Service System, 53 job descriptions, covering the 86 job titles and it is these descriptions as interpreted and amended by Selective Service that controls rather than the title itself.

If an electric company asks for deferment of a man whom it knows is in a critical occupation as contemplated by the regulations, it should be able to convince the local draft board that that man falls in one of the 86 job titles listed. All agencies of the Selective Service System may request information on job description from the System's National office to assist them in their consideration of the registrant's case.

The policy of the National Headquarters of the Selective Service System, as announced since Pearl Harbor plunged us into war, is well laid out in their Memorandum I-405 issued on March 16, 1942. Copies of this Memorandum can still be secured either through the local draft boards or State directors of Selective Service.

It furnishes a reliable guide to those who must keep essential industries operating and at the same time are trying to perform their patriotic duty and contribute every possible human or mechanical facility to the war effort.

Drafting of men for the armed forces is not the only personnel problem which electric utilities have to face. Constrained by fixed rates and mounting taxes, it is impossible for operating companies to compete with the skyrocketing wage and salaries paid in war production plants.

Wage scales in our industry have always been well up toward the top and still compare reasonably well with wages paid in other industries. Continuous employment, pension plans and the stability of the business have always attracted the most competent men and women so that now expanding war production activities find a fertile field for trained and capable personnel.

Many attracted by the larger pay envelopes provided by much overtime have left their long-time careers to take a flyer in the new venture. Recent statements from the Chairman of the new War Manpower Commission announce that measures to prevent the pirating of essential war workers are being drawn up and will eventually be issued.

The fact that the electric power industry has been officially declared to be essential to the support of the war effort places it in a position to benefit from whatever plan is announced and should assist in protecting the 86 critical listed occupations against this sort of pirating.

One other phase of this personnel problem which may become more acute is the possibility that men now classified as 3-A or 3-B because of dependents may be drafted. National Headquarters of the Selective Service System recently outlined a new more rigid policy on the classification of men with dependents.

With provision for compensation for the dependents of drafted men, there may be a wholesale drafting of these men. No manager should feel too confident that he will be allowed to retain an employe because he now has a Class 3-A or 3-B rating, and active training of replacements for men with limited dependency should be considered.

Every Able Bodied Man Faces Induction

The personnel picture for electric companies is clear if not too encouraging and can be simply stated—somewhere down the line every man subject to and qualified for the draft faces the possibility of induction in the armed forces.

If he is now in a critical job, he can be deferred from time to time as may be necessary to secure or train a qualified man to take his place, but there is no assurance that he will be deferred indefinitely. If he is not in a critical job, he cannot be deferred.

A necessary man in a critical job, not subject to the draft should not be available to a war industry under the policy to be announced by the Manpower Commission. A man not in a critical job is exposed to all the lures of high-paid war work and the tendency will probably be to steer him that way.

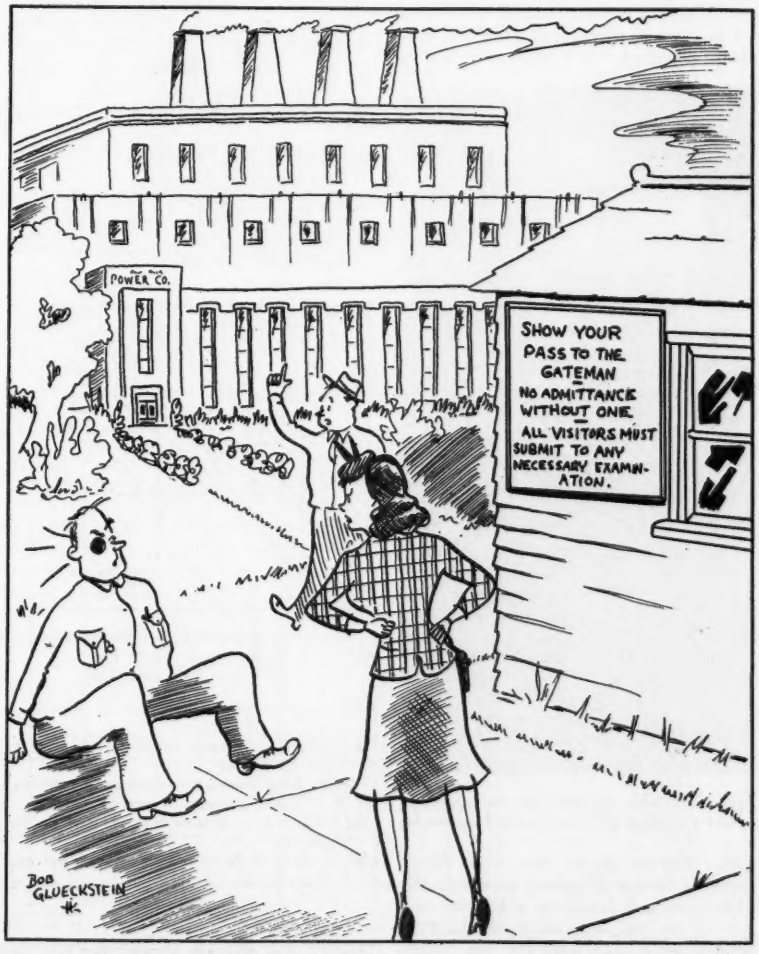
When a company finally places non-draftable men in all its critical positions, and fills all non-critical jobs with women or men not suitable for war production plants or subject to the draft, then its personnel may be considered stabilized—at least until some change such as the lowering of physical or mental standards for induction is made and there results a reclassification of exempt men.

Of course, once the war is over, and men return from the service expecting to find their old jobs waiting, or, those who took a flyer in war production again seek a place in industry, much of the shifting now going on will have to be unwound. Then a new chapter will begin, the outlines of which now cannot even be surmised.

EDITOR'S NOTE: About the middle of July (Release 279, SS File: vol. VII), Washington issued more specific instructions to Local Boards who are now authorized to consider for selection, registrants in the following order: (1) Single men with NO dependents; (2) single men WITH dependents and who DO NOT contribute to the war effort; (3) single men WITH dependents and who DO contribute to the war effort; (4) married men WITHOUT children and who DO NOT contribute to the war effort; (5) married men WITHOUT children and who DO contribute to the war effort; (6) married men WITH children and who DO NOT contribute to the war effort; and, (7) married men WITH children and who DO contribute to the war effort.

To be classed as a married man, a registrant must have been married before Dec. 8, 1941, or before induction was imminent and, must be living with his wife, wife and children, or, children only. Contributing to the war effort means he or his employer must be: fulfilling a war contract; performing a government service; a service necessary to civilian life in support of the war effort; or supplying material (raw or manufactured) for some of the above. To be deferred the registrant must not only be engaged in one of these activities but must be a "necessary man."

For guidance, essential activities are classified as: Production of aircraft and parts; ships, boats and parts; ord-

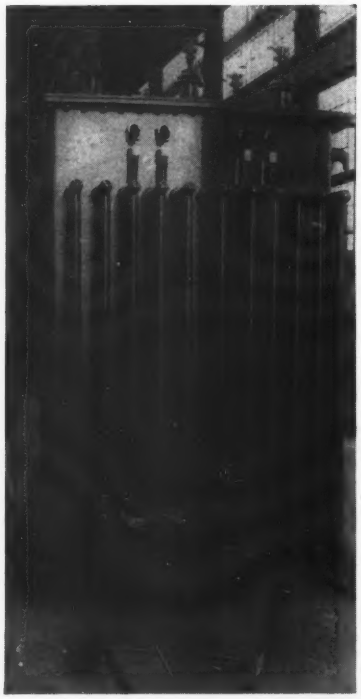

POWER CO.
SHOW YOUR PASS TO THE GATEMAN
NO ADMITTANCE WITHOUT ONE.
ALL VISITORS MUST SUBMIT TO ANY NECESSARY EXAMINATION.
BOB GLUECKSTEIN

"Er —— Jones —— I don't think it's necessary to 'frisk' the young lady!"

nance and accessories; ammunition; agriculture; food processing; forestry, logging and lumbering; construction; coal mining; nonmetallic mining and processing and quarrying; smelting, refining and rolling metals; production of metal shapes and forgings; finishing of metal products; production of industrial and agricultural equipment; machinery; chemicals and allied products; rubber products; leather products; textiles; apparel; stone, clay and glass products; petroleum, natural gas and petroleum and coal products; transportation equipment; transportation services; materials for packing and shipping products; communications equipment; communications services; heating, power and illuminating services; repair and handtrade services (blacksmithing, armature rewinding, electrical and bicycle repair, leather repair, clock repair, tool repair and sharpening); health and welfare services; educational services (including professional engineering); and governmental services.

Increasing Transformer Capacity

WAR SERVICE is placing overloads on many transformers and other self-cooled equipment. Auxiliary cooling air needed for this extra service can often be supplied effectively and economically by



Typical portable air blast unit for supplying auxiliary cooling air to self-cooled apparatus

fans. The one shown above is a Westinghouse design delivering approximately 2100 c.f.m. and driven by a 1/12-hp. motor. Note the self-contained stand of welded angle iron with the fan adjustable at any angle.

Psychrometric Calculations For High Altitudes

By CHO-LAN YIN*

EVER SINCE the remarkable experiments by W. H. Carrier and the subsequent Rational Psychrometric Formula which appeared in the Transactions of the American Society of Mechanical Engineers, 1911, psychrometric charts of various designs have been proposed to facilitate the solving of problems in air conditioning, drying, and water cooling.

Most of these charts are drawn for a constant barometric pressure of 29.92 Hg. and are satisfactory for solution of ordinary problems. The Bulkeley Chart[1] appearing in the Transactions of A.S.H.&V.E. 1926, has been adopted as the official psychrometric chart of the Society.

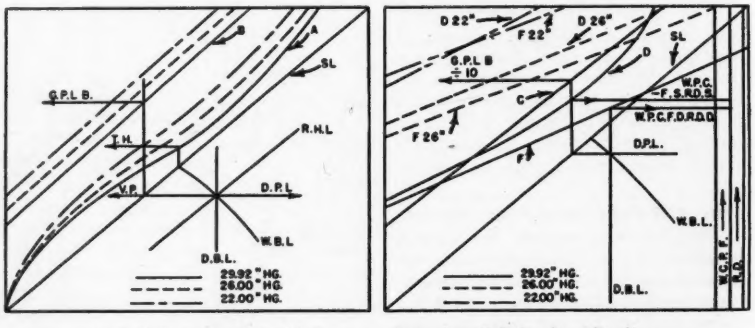
During the years of practice and teaching of air conditioning, the author has been impressed with the general acceptable neglect of total pressure variation in air, particularly, in the matter of effective temperature and comfort zone. Laboratory experiments have been planned, whereby with the other conditions remaining the same, the effect of the change of barometric pressure on body-comfort may be closely studied.

With the moving about of the University during an interval of several months, the author traveled from Peiping to Changsha and again from Changsha to Kunming. The last named city is over 6000 ft. above the sea level, corresponding to a barometric reading of about 24 in. In a sense, the author carries with him the experiments like a wandering gypsy. No definite data could be obtained for presentation, but instead, the idea has struck home that at least a psychrometric chart should be prepared for pressures other than the standard. The chart is based on the Carrier Rational Formula and was plotted, according to the A.S.H.&V.E. official Bulkeley Chart design, by the author and C. H. Chen of the National Central University.

The chart itself is shown on page 89. An explanation of the various directrix lines and use of the chart is shown by Fig. 1. For simplicity in reproduction the curves for 29.92 in Hg. as shown by the standard Bulkeley Chart have been omitted and only the values for 22 and 26 in. Hg. appear.

*Professor of Mechanical Engineering, National Tsing Hua University, China.

[1]The Bulkeley chart drawn for 760 Mm. barometric pressure is included in the back pocket of the A.S.H.&V.E. Guide. It may be purchased separately (16 by 20 in. on heavy paper) for 25 ct. per copy from the American Society of Heating & Ventilating Engineers, 51 Madison Ave., New York City.



A, B, C, D, E, F = Directrix lines
D, B, L = Dry bulb line
D, P, L = Dew point line

R, N, L = Relative humidity line
W, B, L = Wet bulb line
S, L = Saturation line

G, P, L, B = Grains moisture sat. mixture per lb. dry air
T, H = Total heat sat. mixture per lb. dry air
V, P = Vapor pressure in mm. of mercury
G, P, C, F, S = Grains moisture per cu. ft. sat. air
W, D, A, C, F, S = Weight dry air per cu. ft. in lb. sat.

R, D, D, S = Relative density dry air per cu. ft., sat.
W, P, C, F, S = Weight per cu. ft. in lb., sat.
R, D, S = Relative density in cu. ft., sat.
W, P, C, F, D = Weight per cu. ft. in lb., dry
R, D, D = Relative density per cu. ft., dry

Fig. 1. Key diagrams showing the procedure to follow in using the revised Bulkeley chart which appears on page 89

DEW POINT, IN °FAHRENHEIT
RELATIVE DENSITY (0.075 LB./ CU.FT. = UNITY)
WEIGHT OF ONE CU. FT. OF AIR IN LB
DRY-BULB TEMPERATURE, IN °FAHRENHEIT
WET BULB TEMPERATURES TO
LB. / CU. FT. DRY — F
GRAINS / CU. FT. — C (FOR ALL PRESSURES)
A 22"
B 22"
D 22"
F 22"
A 26"
B 26"
D 26"
F 26"
VAPOR PRESSURE MILLIMETERS MERCURY (DIVIDE BY 25.4 FOR IN.)
TOTAL HEAT (BTU) / LB. DRY AIR SATURATED WITH MOISTURE — A
GRAINS MOISTURE / LB. DRY AIR SATURATED WITH MOISTURE — B
DIVIDE BY 10 FOR GRAINS MOISTURE / CU. FT. SATURATED AIR — C

Psychrometric chart drawn by Prof. Cho-Lan Yin for barometric pressures of 22 and 26 in. Hg. (approx. elev. 2700 and 8800 ft. above sea level). For further explanation see Psychrometric Calculations for High Altitudes, page 88

INDUSTRIAL POWER MANAGEMENT

No matter how efficient the design of an industrial power plant or how modern its equipment, minimum power service costs depend in a large measure upon the co-operation given operating personnel. Here an enlightened management can well reap a golden harvest

By S. H. COLEMAN

INDUSTRIAL power service costs in all of their many and varied phases constitute a far larger portion of production expense than is generally realized by management. It is hard to place definitely the underlying reasons contributing to this mental attitude, but it can be safely said that obsolete ideas concerning the functions of the power department and its personnel are in a large measure responsible. Until these misapprehensions are dispelled and modern power management practices given an opportunity to prove their worth there is little hope of betterment. On the other hand where management fully appreciates the dividends, both tangible and intangible, latent in an up-to-date power policy, the cost of power services per unit of finished product will, in almost every case, trend steadily downward.

What should constitute the primary functions of the modern industrial power section and how do these functions blend into the functional organization of the plant as a whole? An intelligent answer to these questions must necessarily take into account local conditions. Among the variables to be considered are size of plant, extent of and demand upon power service facilities, and whether or not the major services namely electricity, process steam, water, compressed air and refrigeration have their origin within the plant itself or are acquired wholly or in part by purchase from an outside source.

In general, however, it may be taken for granted that in all plants generating their own power services the power department should be made responsible not only for the generation of these services but also for their distribution and to a large degree for their utilization. Allocating responsibilities in this manner will promote greater efficiency in that all costs incidental to these various services are placed under one control. Where power services are purchased this setup must of course be modified, but centralization of supervisory control over distribution and so far as is possible utilization should still be given consideration.

Industrial management can do much to make a program based on the foregoing outline effective. So far as the selection of key personnel is concerned it must keep in mind that the supervision of power services in medium and large plants requires engineering ability of the highest order coupled with personal qualities that will inspire co-operation, both of employes within the power department itself and of departmental heads and personnel in every other section of the organization. It must also remember that these attributes are not enough unless full co-operation is given in the matter of organizing the power section so that it and its personnel can function with maximum effectiveness and minimum friction.

Shown in the organization chart Fig. 1, is an especially cohesive power department arrangement successfully used for a number of years in the many plants of a nationally known chemical manufacturing concern. From this chart it can be readily ascertained who is responsible to whom and in a general way the extent of individual job coverage.

To the uninitiated who are familiar only with organizations in which the rightful functions of the power section are split up and submerged in other departments where they are usually considered of secondary importance, this chart will indicate too much segregation of responsibility. It must be remembered however, that the efficient operation of industrial power generating stations depends largely upon the relative quantities of steam and electricity used in the production of salable goods.

Not only must the number of units of these two services needed to process a unit of finished product be held at the lowest possible value, but electrical and steam demands must also be balanced in order to avoid waste of energy. It is therefore only fitting that the power supervisor be given as much control as is possible over these relationships. Then too as distribution costs must be added to the generating costs of these and other power services so that a true cost breakdown can be obtained, accounting will be simplified by centralization of responsibility for results.

Attainment of these aims with as little duplication of effort as possible is accomplished by dividing the power section into five sub-sections namely generating, electrical, distribution, maintenance and results.

In this classification are all services generated in the power plant proper. Responsibility for the efficient operation and the reporting of needed maintenance of all equipment, direct supervision of operating personnel, and related functions is placed in the hands of engineers in charge of each operating shift. Their administrative authority covers every detail of the generating station beginning with the fuel storage and ending at the points where the various distribution feeders and pipe lines pass through the power house wall. The many different phases of this job are common to most plants, and so will not be given further space here.

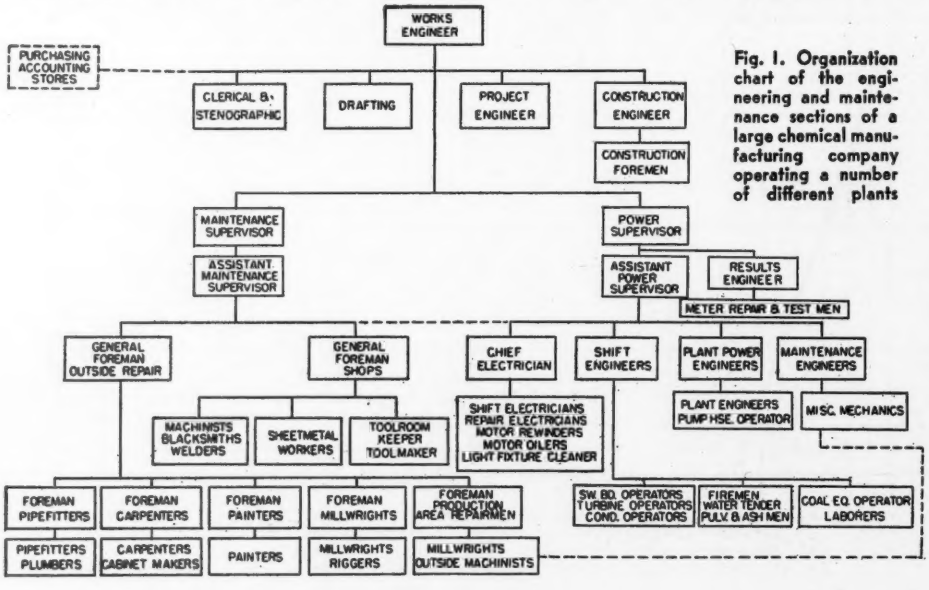


Fig. 1. Organization chart of the engineering and maintenance sections of a large chemical manufacturing company operating a number of different plants

Under supervision of the chief electrician are a heterogeneous collection of responsibilities. Included among these are the operation and maintenance of distribution circuits, inspection and repair of all electrical devices used in the generation and distribution of power services and similar duties directly chargeable to the cost of these services. Maintenance and inspection of process motors, heaters and lighting is done on work orders issued by and charged to the affected department. Motor oiling and lighting fixture cleaning is also taken care of by the electrical division personnel and the cost pro-rated among the various manufacturing and service sections.

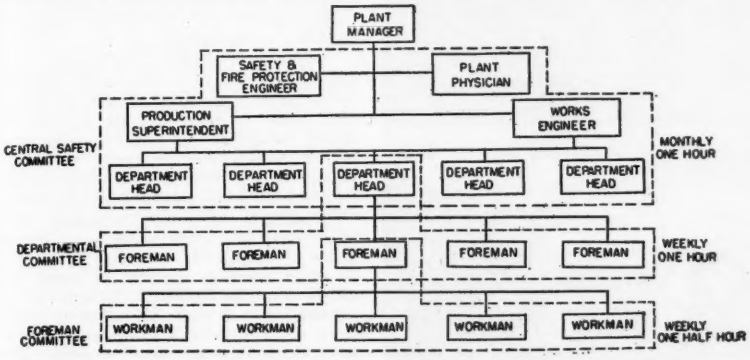


Fig. 2. An organization conference chart intended to promote interdepartmental relations

Power Service

Falling in this category are many diverse and seemingly unrelated responsibilities all assigned to the plant power engineer and his subordinates. Not only are these men given control over operation and maintenance of all power service distribution equipment other than that handled by the electrical division, but they must also look after a number of indirect services. Among these are heating, ventilation and air conditioning; sewerage disposal; condensate return systems; and the serving in an advisory capacity whenever process equipment using steam, water, compressed air or refrigeration is to be installed or repaired. Then too all power service generating equipment outside the power plant proper such as process and drinking water pumps, isolated compressors, mechanical drive turbines, and refrigerating machines must be taken care of by this subsection.

Co-ordination of the loads imposed by these services whether they be direct or indirect is a most important factor in obtaining an efficient heat balance that will assure minimum fuel consumption for a given production rate. Both for this reason, and to aid in accurately determining cost breakdowns, are responsibility for operation and supervision of maintenance covering as far as is practical all of these services entrusted to the power division where integrated control by men skilled in thermodynamics and the related sciences is available.

Here the functions of the power and maintenance departments overlap slightly. The maintenance engineer is an employe of the power department while the different mechanics coming under his supervision are nominally employes of the maintenance department, assigned however, to permanent duty in the power division. This has been done because the specialized nature of the various jobs made it inadvisable to entrust their performance to mechanics, no matter how skilled, with no previous experience in maintaining the particular equipment involved.

This sub-section is responsible for the inspection and repair of all mechanical equipment coming within the direct jurisdiction of the power division. Shop work, major piping, welding, brickwork and like jobs required so infrequently that the services of permanently assigned mechanics having the trades involved are not justified so far as the power department is concerned, are done on work orders by the main plant maintenance department.

In order to co-ordinate the various functions of these sub-sections a results division headed by a technically trained engineer, who is made directly responsible to the power supervisor, is included in the organization set-up. Instrument repair and testing personnel are under supervision of the results engineer who directs their activities.

All reports, charts and log sheets relating to power services are handled by this sub-division. Should the calculations made from this data indicate any adverse factor affecting power service conservation the power supervisor is informed. Where the power department alone is concerned the power supervisor makes the required changes in operating or maintenance procedure through the ordinary administrative channels. In the event production divisions are at fault he makes the necessary overtures.

The Human Factor

Management's interest in the power department should not stop with purely organizational problems. The human factor must also be given consideration. Every reasonable opportunity should be given the power supervisor and his staff in the all important matter of keeping up-to-date. These men should be encouraged to join technical and engineering societies and should be sent on the firm's time and expense to conventions and power shows in order that they may keep abreast of new developments and exchange ideas with other men in the same field.

They should also attend conferences of department heads and foremen dealing with safety, personnel relations and manufacturing problems that may by any chance affect the power department. A typical conference organization chart shown in Fig. 2 will give an idea of how this can be handled. Although this particular chart deals with safety conferences a similar arrangement can be worked out to deal with other problems. It is well to mention at this point that contacts of this kind are just as important in reducing power costs as are the trade associations and sales conferences to the reduction of manufacturing and product distribution costs.

In the matter of subordinate power plant personnel management can also do much to increase the efficiency of the power department. Co-operation with the power supervisor in the selection of personnel, wages commensurate with responsibility, working conditions in accord with modern practice, vacations with pay, etc., are all essential if excessive labor turnover is to be avoided. Technical magazines, correspondence courses and like training facilities paid for all or in part by the company will do much to promote operator efficiency. After all, satisfied and effective human beings who wish to keep their jobs are as much an asset as the finest boilers and turbines.

Dope for Screwed Joints

FOR STEAM TIGHT screw joints, many engineers use a mixture of cylinder oil and graphite. The following mixture suitable for both steam and water pipes: Ten pounds fine yellow ocher; 4 lb. ground litharge; 4 lb. whiting and ½ lb. hemp cut up fine. Mix thoroughly with linseed oil to the consistency of putty.

For ammonia pipe joints use a mixture of litharge and glycerine. This filler sets so quickly, however, that only enough for one joint should be mixed at a time, and when the joint is once made it should not be disturbed as the filler is useless if broken after having once set.

Fig. 1. Subbases must be firm, level and smooth. Hot liquid pumps should not be anchored

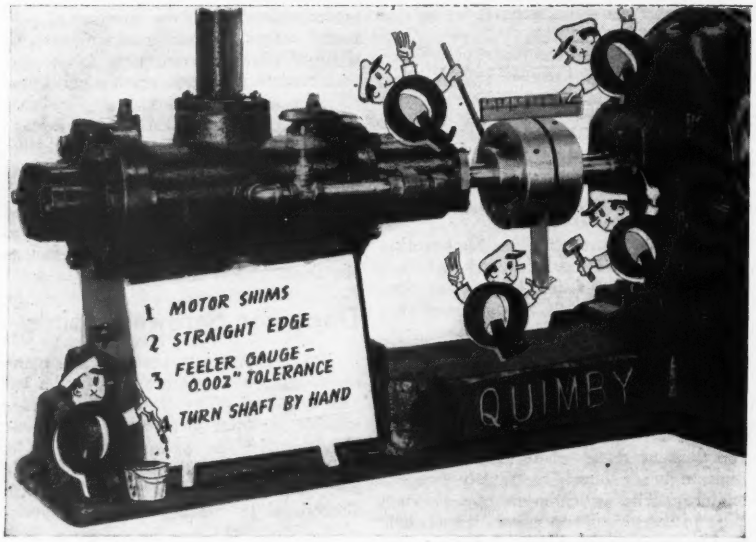


Fig. 2. Proper alinement of pump and motor is the first step for long trouble free service

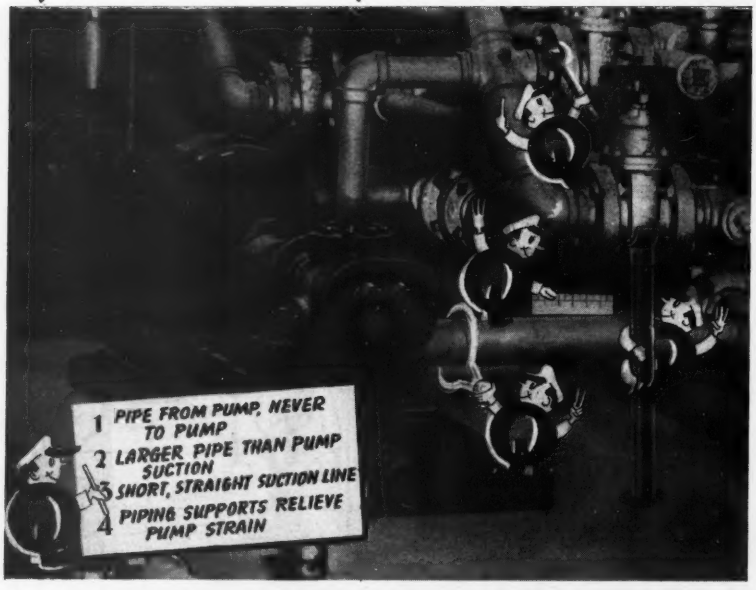

1 PIPE FROM PUMP, NEVER TO PUMP
2 LARGER PIPE THAN PUMP SUCTION
3 SHORT, STRAIGHT SUCTION LINE
4 PIPING SUPPORTS RELIEVE PUMP STRAIN

Fig. 3. All piping should start from the pump and be supported so as to remove all strains

'Cues' For

By WM. T. QUIMBY
Quimby Pump Co., Inc.[1]

PROPER installation, intelligent operation and careful maintenance are three essentials of long trouble-free pump service. The following article covers certain essentials of good practice common to all rotary, screw and centrifugal pumps regardless of make or type.

Permanent alinement is the first essential and demands a firm, solid and level foundation or support so that the bedplate will bear evenly at all points. Hot liquid pumps should not be anchored but set on rollers free to move with piping expansion. Other pumps can be anchored firmly with bolts or with grout alone.

Bedplates of pumps requiring no anchor bolts are often made with grouting holes in the top to facilitate pouring and to get a uniform support of grout under all parts of the bedplate. Grout, however, should be used only on concrete foundations so as to form a good solid bond and hold the unit firm. Also the grout should not be poured until the pumping unit is perfectly and permanently lined up. This can be done by placing steel wedges between the bedplate and top of the foundation. These wedges should be tapped on the outer ends until all set firmly and the unit is in line. They should remain in place permanently, set in the grout.

Before grouting build a dam about 2½ in. high around the outside of the bedplate. This may be of wood or other suitable material and should remain in place until the grout has hardened. When foundation bolts are used they should be set in the concrete foundation, in boxes, tubes, or pipes, so that the bottom end is firmly anchored with the upper end free to move sideways to permit lining up accurately with the holes in the bedplate.

After the grout has hardened, the anchor bolt nuts should be screwed down finger tight. This avoids distorting the bedplates and disturbing the alinement. Alinement should be checked frequently as it may change due to wear of the flexible coupling; bearing failures, broken shafts and packing troubles may result. Whenever possible check flexible coupling halves with feeler gages to make sure that the coupling faces are parallel, and, with a steel straight edge, laid across the flanges while revolving the rotor, to see that the two halves match on centers.

Alinement should be within 0.002 in. in all directions. If misalinement occurs after installation, shims may be used between the pump and/or the motor bedplate. If the pump or driver or both are heated in service, alinement should be tested at the operating temperature since expansion may affect it.

After the pump has been correctly installed, the pipe connections may be made. Both suction and discharge piping should start from the pump to avoid any possibility of having to force the pipe into position for connection to the pump. This will exert a strain on the pump casing and frequently causes misalinement. All piping must be properly supported inde-

[1]Copyright, 1942 by the Quimby Pump Co., Inc.

Pump Care

pendently of the pump casing in such manner that the weight of piping or its expansion and contraction cannot impose strains on the pump.

Suction lines should be as short and direct as possible and absolutely airtight. Pipe and fittings should be larger in diameter (never smaller) than the opening on the pump to keep flow resistance at the minimum. For a pump operating with static suction lift avoid all air pockets in the line with no part higher than the connection to the pump inlet.

Discharge piping should never be smaller than the pump connection (preferably larger) and should be as direct as possible. There should be no sudden changes of area in the pipe line or short or abrupt turns.

Pressure relief valves should be installed in the discharge lines of all positive displacement type rotary pumps as protection to the pumps against excess pressure from a closed valve.

Be sure that all lines are clear of dirt, scale, waste, tools or other foreign material before starting the pump. Before starting, also make sure that the pump motor is wired to rotate in the right direction, as indicated by the arrow attached to the pump casing. A momentary application of power is sufficient for this test.

Stuffing box should be examined and cleaned before inserting packing. A composite and formed semi-metallic packing is usually most satisfactory for pumps handling oil. For fresh water service use graphited flax; for acids and corrosive solutions, a long-fibre asbestos is suitable. Packing rings should be a neat fit to the shaft and stuffing box bore, and when in place the joint in each ring should close. Stagger the joints of alternate rings so that they do not come in line.

When the stuffing box is filled, tighten the gland to make sure all rings are close together. Slack off gland nuts so that there is no excessive pressure on the packing. After the packing has expanded and pushed the gland to normal position, set up gland nuts finger tight. Should the packing leak excessively after running a short time, insert additional packing.

For best operation the gland should be permitted to leak slightly several drops per minute. This will lubricate the packing and reduce wear to the minimum. When this slight leakage is inadvisable because of high value or inflammability of the liquid, packing should be replaced frequently to prevent shaft scoring.

Do not permit a pump to stand idle for long periods. Run it from time to time for a few minutes during such intervals, if possible, or turn the pump over by hand or bar at least once a week.

If the pump binds after standing idle, due to oil or other material hardening in the rotor clearances, turn the shaft slowly backwards for one complete revolution and rock gently back and forth to start. If the pump seems too tight to move in this way pour some solvent into to discharge.

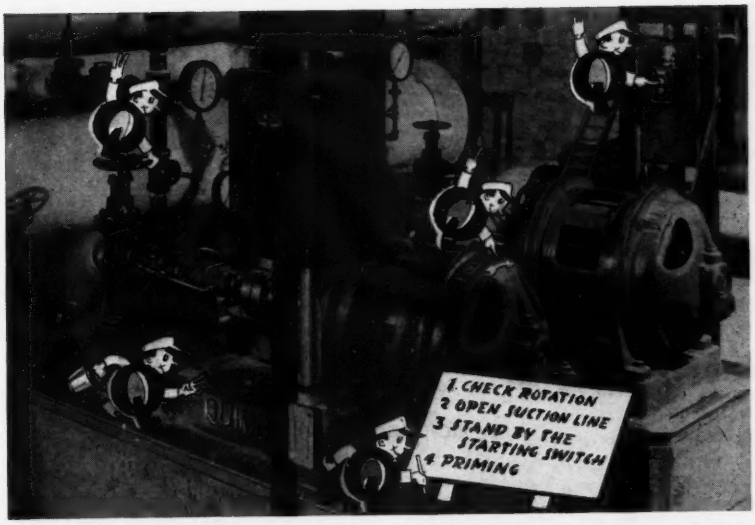


Fig. 4. Before starting operation, the motor should be fully checked for proper rotation

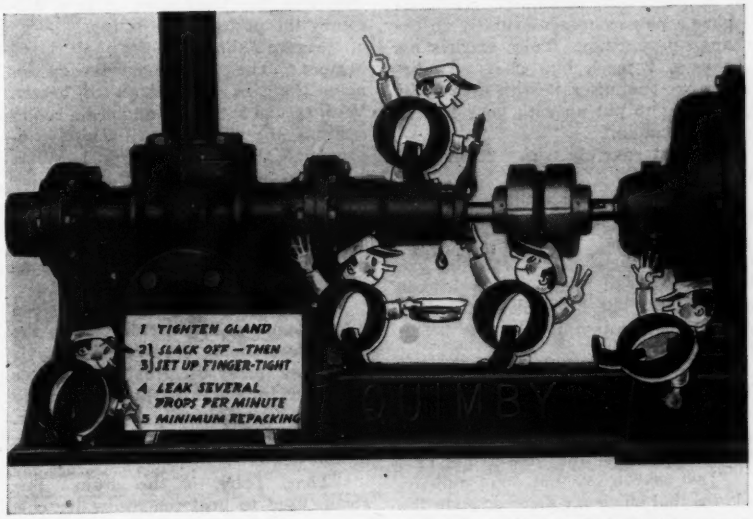


Fig. 5. Packing should be fitted to the particular job, with glands pulled only finger tight

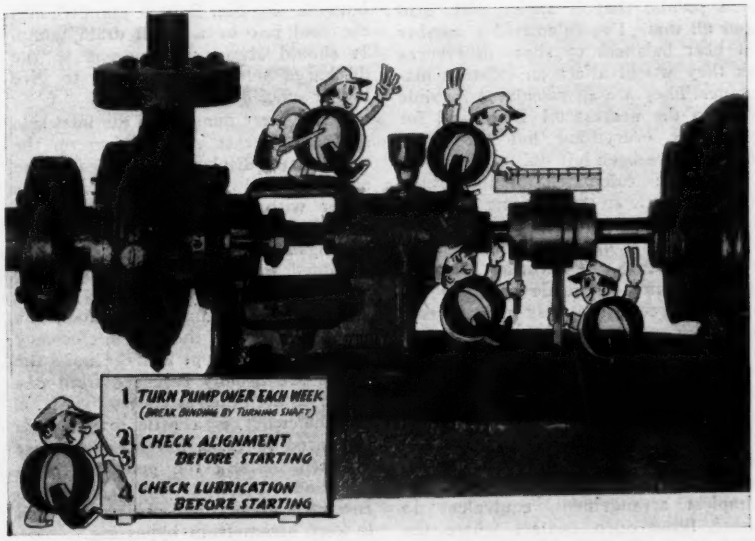

1 TURN PUMP OVER EACH WEEK
(BREAK BINDING BY TURNING SHAFT)
2 3 CHECK ALIGNMENT BEFORE STARTING
4 CHECK LUBRICATION BEFORE STARTING

Fig. 6. Standby pumps should be turned over occasionally and checked before running

THE ENGINEER'S PRIMER-IV

Andy has a session with Mac to convince him that heat balance studies are not only useful but offer possibilities of indoor recreation. Mac, who concedes their usefulness, is skeptical of what Andy calls sugar coated education and has asked him to show, in a simple way, how it works. Mac hooted when Andy said they worked at heat balances all one winter in preference to working crossword puzzles, but admits he himself has put in many hours doing it—partially because he had to, partially because he wanted to learn and partially because he liked to do it. Andy insists that if a man's an engineer at heart, he will not rest easily until he has figured out the "why" for himself

By RICHARD H. MORRIS

"COME IN, Mac. I thought you forgot all about the heat balances you challenged me to make and had lost interest in progressive education. However, I have a new customer—strictly an exchange proposition. Toby teaches me checkers, I teach him chess. In between we commiserate with each other on having to put up with your limited mental faculties."

"Still at your old tricks stealing my men, Andy?"

"Not this time. I could use one or two engineers, but Toby needs some years under his hat before he'd qualify even in these times. It's too bad he has to spend them in your broken down plant, but he can't get in the Army and even your place is better than starving."

"You can't tell me anything about Toby, Andy, so let's cut out the nonsense and hear your story. I've been away almost a month and have to get to bed before it's time to get up."

"Just as you say, but don't quibble. I know that efficiency depends upon the pressures and temperatures, that it's affected by the location of the extraction points, that it varies with load and all that. I've calculated a number of heat balances to show differences as they would affect an existing machine. They are all calculated by slide rule to the nearest 0.1 B.t.u. and for simplicity everything but the B.t.u. figures have been left off.

"Each is calculated for 1000 B.t.u. to the throttle so that shifting the decimal point one place to the left gives the heat flow direct as a percentage of the heat to the throttle. Also no attempt has been made to show the minor source of heat loss such as vents nor to consider the effect of power needed to drive the auxiliaries.

"Figure 1 is directly comparable to your Fig. 3 (p. 119 May issue), although I notice that you transposed two figures and the efficiency as you calculated it should have been 19.53 instead of 19.35 per cent. This is the simplest arrangement, equivalent to using three open heaters where the bled steam mixes directly with the condensate. There is no point in going into the reasons why the all open heater arrangement is not used more widely, but from the standpoint of heat efficiency the performance is tops.

"Figure 2 shows the use of all closed heaters. The performance depends upon the size and design of heater. With special superheat and drain cooler sections, the efficiency will closely approximate that shown by Fig. 1. While a 5 deg. temperature differential between the steam saturation temperature and the outgoing condensate is a good practical value, Fig. 2 has been drawn for a 10 deg. differential so as to show up the difference.

"There is some difference between the amounts of steam extracted in the two cases and the drop in efficiency is accounted for by the greater condenser loss and the fact that the return to the boiler is practically 8 B.t.u. lower. What is the little hook at the bottom of the heater?

"That, Toby, is the drain. The steam used to heat the feedwater collects in the bottom of the heater just as condensate does in the condenser hotwell. In Fig. 2 it is pumped into the feed line by a small drain pump. It should always be pumped to the discharge side of the heater to give higher efficiency.

"If it were pumped to the inlet side of the heater it would warm up the condensate, displace some bled steam and the feedwater would go to the boiler with only 183.3 B.t.u. If you pump to the discharge side as shown by Fig. 2, the 11.7 B.t.u. in the drain is added to the 183.3 to make 195.0 B.t.u.

"The drain pumps are small, the service severe and the gain in efficiency small so that except in large units the drains are usually cascaded from one heater to the other as shown by Fig. 3. The efficiency is a little lower, 19.23 compared to 19.36, but no pumps are required because the pressure forces the condensate from one to the other. In fact, traps or small orifices are used to keep steam from bypassing.

"Heat in the drains, of course, causes some loss. This heat bypasses the turbine and is throttled from one heater to the next. The drains also flash in the next lower heater and thus displace some bled steam from the next lower point. All of the drains eventually end up in the condenser and are a source of added condenser loss.

"By adding a heat exchanger, as shown dotted at A of Fig. 3, some of this heat is reclaimed from the condenser and the efficiency increased from 19.23 to 19.28 per cent. This is used to some extent, but if the drains are returned to the hotwell properly most of the heat can be recovered in the condensate without the complication of a heat exchanger.

"Or all the drains can be cascaded to the low pressure and pumped into line ahead of the low-pressure heater—one pump instead of three and the efficiency is a little higher, 19.40. The heat to the boiler is the same, but the condenser loss is reduced slightly.

"At present a few plants are using all closed heaters, depending upon the condenser for deaeration. The majority, however, prefer to use one deaerating heater, operating slightly above atmospheric pressure, as shown by Fig. 4. The efficiency is good, 19.42, and the arrangement is simple and effective.

"For comparative purposes a heat exchanger is shown in the low-pressure heater drains. This exchanger reclaims 2.1 of the 5.4 B.t.u. If it were not used, this 2.1 B.t.u. would be supplied by additional extracted steam. This would reduce the heat flow from the turbine to the condenser slightly more than this due to the extra power developed. But the 2.1 B.t.u. so saved would be carried to another point in the condenser by the drains. There is no point in spending money to save a B.t.u. one place and lose it at another.

"This is also shown by Fig. 5, using auxiliary exhaust in place of extracted steam. The whole picture cannot be shown in such a simple diagram, but I believe you brought out the point at our last session (May issue p. 118) that steam driven auxiliaries can never equal motor driven auxiliaries from the standpoint of thermal efficiency alone.

"Figure 5 is drawn so as to give all the breaks to exhaust steam—on the assumption that if it were not used it would be wasted. Normally this steam would be used in an open heater, but a closed heater was assumed so as not to introduce complications due to the additional steam added to the cycle.

"As far as heat is concerned it makes no difference. The condensate will pick up 44.7 B.t.u. If this heat is not charged to the turbine the efficiency jumps to 19.95 per cent due largely to the increased power developed from the steam which is not bled in this case but which expands to the turbine. However, if this 44.7 B.t.u. is charged to the turbine, the efficiency drops to 18.90 per cent.

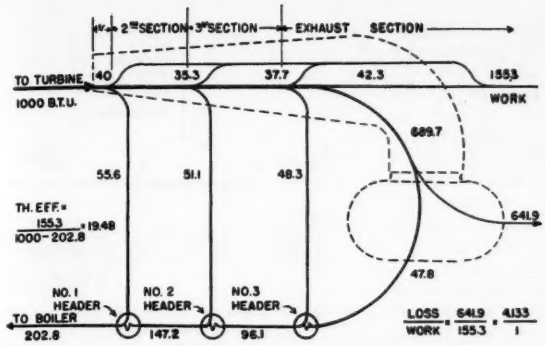


Fig. 1. This arrangement, equivalent to using all open heaters, is the most efficient because it heats the condensate to full saturation temperature of the extracted steam

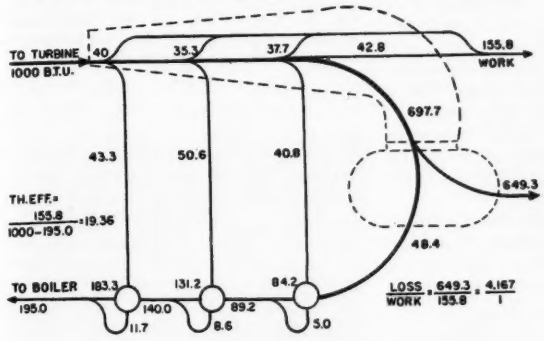


Fig. 2. With closed heaters, pumping the heater drains to the discharge side is a close approach to Fig. 1. With large or special heaters the difference becomes very small

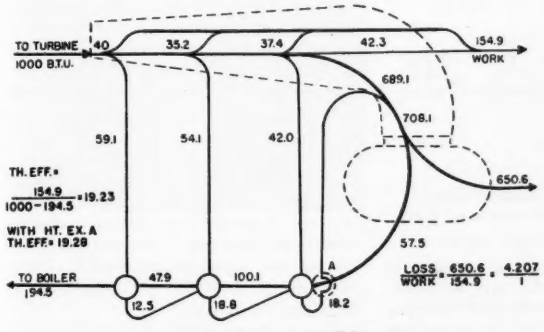


Fig. 3. Cascading the drains to the next lower heater is simpler than pumping as in Fig. 2 but less efficient. More steam is bled but it is not used as effectively. Adding a heat exchanger at A improves the efficiency slightly. Pumping all the drains to the discharge side of the low-pressure heater gives an efficiency almost equal to Fig. 4

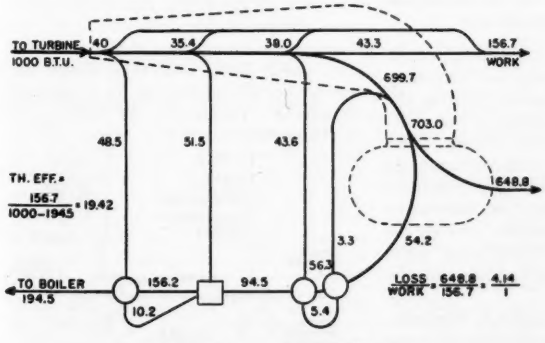


Fig. 4. This arrangement with a deaerating or open heater in the cycle is a popular and simple one offering high efficiency. The arrangement shown above is directly comparable with Fig. 3 using the closed heaters with the heat exchanger A added

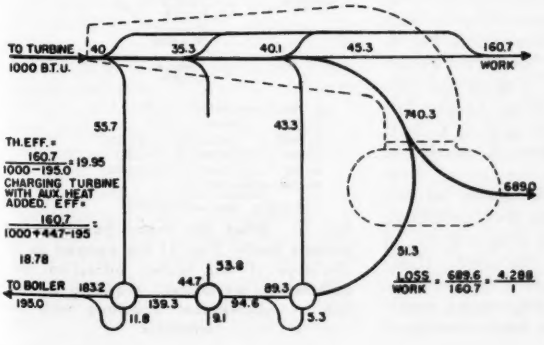


Fig. 5. While not justified from a thermal standpoint, use of auxiliary exhaust is sometimes desirable in practice. Here, in a layout approximately comparable with Fig. 2, auxiliary exhaust replaces bled steam. The power output, for a given throttle flow is increased, but 90 per cent of the extra heat added is later lost in the condenser

"Due to the increased steam flow to the condenser, the condenser loss is increased 39.7 B.t.u. (over Fig. 2) or nearly 90 per cent of the 44.7 B.t.u. saved from the auxiliary exhaust. The rest is mostly taken out in useful work."

"The diagrams are easy enough to follow, Mr. Andy, but how do you figure them all out? It seems to me that when you take a little bit off here and a little bit there it gets too complicated to follow."

"It can be made complicated, Toby, but it can also be made simple. First you need to know the pressure, or saturation temperature, and the heat content in B.t.u. per lb. for each of the extraction points at the turbine load you are working with. The pressure at the heater will be slightly lower than at the turbine casing due to losses through the piping and non-return valves. Then if you are mathematically inclined and have a lot of patience you can make the layout you want and work out a complicated set of simultaneous equations letting x, y and z equal the quantity of steam bled at each point.

"However, an easier method can usually be found by taking the system piece-meal, remembering that the heat flow into any piece of equipment, or combination of equipment, must equal the heat flowing out. Also steam cannot heat the condensate above the saturation temperature and, in a closed heater, there will be a differential of 5 to 10 deg. With high pressures it is simpler to assume the differential is in B.t.u. rather than degrees F.

"Thus take Fig. 1. It is plain to see that all the steam that passes the throttle leaves the high-pressure heater, but that the condensate flowing to the heater is the throttle flow minus the steam extracted at the first extraction point. By isolating this high-pressure heater, as shown by Fig. 6, the amount of steam extracted can be worked out easily. Then the same procedure can be followed in turn with the other two heaters.

"In Fig. 6 data for the bled steam is known. The flow to the heater is not known, but the heat content is for it is heated to the saturation temperature of the steam bled to the intermediate heater. (At low pressures this can be assumed as the heat content of the feedwater although this is much below the saturation temperature and must be corrected for at high pressures[1]). Also the heat content of the condensate leaving the heater is known from the pressure conditions of the bled steam.

"Heat going into the heater is A and B, that leaving is C. Working out the equation $A + B = C$ from the figures given in Fig. 6, X is the pounds of steam extracted calculated as 55.9/-964.5. Sometimes it's easier to work out, especially when using a slide rule without putting it all on paper, looking at it another way.

[1]See Compressed Liquid in the Power Plant Cycle, by George G. Guthrie, Power Plant Engineering, P. 364, June, 1938.

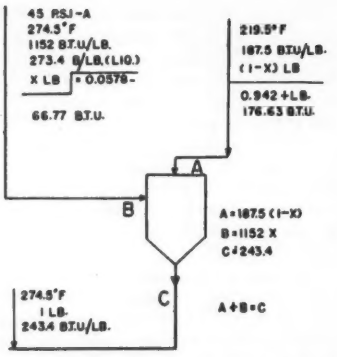


Fig. 6. Calculations for the high-pressure heater of Fig. 1 on the basis of 1 lb. flow to the throttle (Fig. 1 is drawn for 1000 B.t.u.). Data above the heavy line in each group of figures is known, data below the line is calculated. This same method can be used for the intermediate heater of Fig. 4, taking account of course of the extra source of heat in the high-pressure heater drains. Calling this D, then A + B + D = C

"Each pound of bled steam gives up (1152 — 243.4) or 909.6 B.t.u., the difference between the total heat (or enthalpy) and the heat content of the liquid. The steam extracted and condensed is already at saturation temperature of 274.5 deg. so only enough steam need be extracted to heat the incoming water and this is 909.6 X B.t.u. The heat content of this is increased from 187.5 to 243.4 or 55.9 B.t.u. per lb. The quantity is (1 — X) or 55.9 — 55.9X. Equalling these two and solving gives X as 55.9/964.5 as before.

"Unfortunately it is not always practical to begin at the high-pressure heater and work down. In Fig. 2 for instance the water flow to the high-pressure heater is the same as before but, because the intermediate heater drains are pumped in the line, the temperature or heat content entering the high-pressure heater cannot be determined until the intermediate extraction is known.

"At the other end, the flow through the low-pressure heater is unknown and depends upon the quantity of steam extracted at all three points. In this

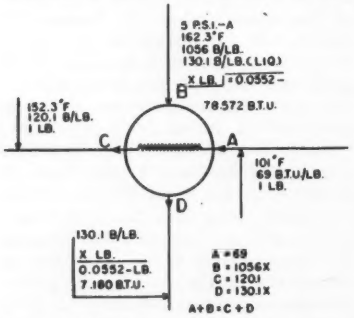


Fig. 7. Calculations for the low-pressure heater of Fig. 2 assuming a flow of 1 lb. from the condenser. This same method can be used for the heaters of Fig. 3 and the high-pressure heater of Fig. 4, making allowance where necessary for the heat added by the drains

case a simple subterfuge is to assume that the flow from the condenser is 1 lb., work the heat balance through on that basis. Then multiply all the quantities calculated by the flow to the turbine throttle. Calculations for the low-pressure heater of Fig. 2 is given in Fig. 7 assuming a 10 deg. temperature differential between the calculated steam temperature and the outgoing condensate.

"In Fig. 3, this same method can be used, but because all the drains go to the condenser, the flow through all the heaters is equal to the throttle flow (neglecting the small gland losses and ejector steam). Calculations can begin at the high-pressure heater and work down, remembering that in the intermediate and low-pressure heaters, there is another source of heat entering. Drains coming in at higher temperatures flash to the temperature of the lower heater and thus displace some bled steam.

"Calculation of the low-pressure heater in Fig. 4, substantially the same as the low-pressure heater in Fig. 3, with the heat exchanger shown dotted,

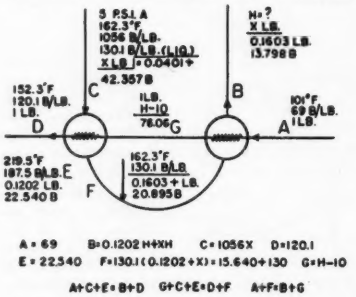


Fig. 8. Calculations for the low-pressure heater of Fig. 3 with the heat exchanger added. This is similar to the corresponding heater of Fig. 4, except for the drains from the higher pressure heaters

is more involved. The condensate flow is known in each case, but the temperature of the condensate entering the heater (needed to calculate the low-pressure extraction) is not known. With a little experience close approximations can be made, or simultaneous equations can be set up involving two unknowns X the extraction in pounds, and H, the heat content of the liquid at a point between the heat exchanger and the low-pressure heater.

"Less work is involved, however, by the method shown by Fig. 8 using the low-pressure heater of Fig. 3 (with the heat exchanger) rather than Fig. 4, because the former involves drains from another heater. Taking the two heaters as a unit as shown by the dotted elipse, the equation is A + C + E = B + D, i.e., the heat in equals the heat out.

"The extraction X cannot be calculated directly because the temperature and consequently the heat content of the drains at B are unknown. However, the lowest possible temperature, allowing the 10 deg. differential, would be 111 deg. F., or a heat content of

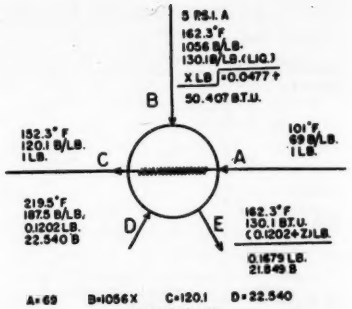


Fig. 9. Calculations for the low-pressure heater of Fig. 3 without the heat exchanger except for the extra drains this is the same as Fig. 7

111 — 32 = 79 B.t.u. per lb. Assuming this temperature, the extraction X can be calculated and a correction made for the flash in the heat exchanger. Several successive approximations can be made quickly until two trials give the same results. This trial and error method is sometimes less involved than solving simultaneous equations.

"When the returns are pumped back from the low-pressure heater as in Fig. 10 a somewhat similar but more involved problem is presented. The extracted steam from the low-pressure heater depends upon the steam extracted from the intermediate heater and vice versa. Three equations can be set up: A + B + C + E = D, taking both heaters as a unit; A + B + F = H + G around the low-pressure heater; and H + G + C + E = D + F involving the intermediate pressure heater. Using the first two Y comes out 0.0569 lb. for the intermediate heater extraction and Z as 0.0391 + lb. for the low pressure extraction."

"And thus, Andy, you have covered the fundamentals. Before you get started on something really involved, I'm going home and take Toby with me so he will be able to do some work tomorrow. Thanks for the evening and good night."

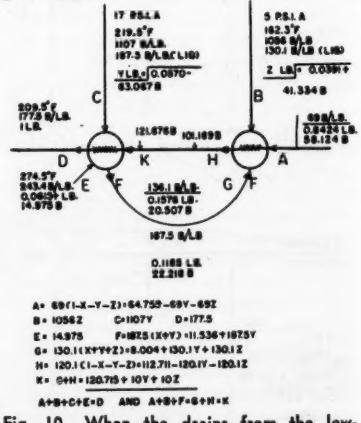


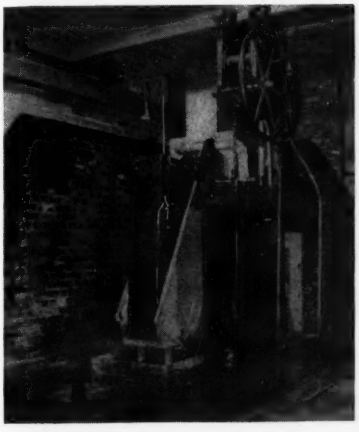
Fig. 10. When the drains from the low-pressure heater (Fig. 3) are pumped to the discharge of this heater, extraction from both heaters are involved, requiring the solution of simultaneous equations with two unknowns

REFRIGERATING PRACTICE

Cutting Ice Harvesting Time

By GEORGE HOLMAN

BY INSTALLING a short length of pipe A and a skid plate B, the capacity of this spray-melting can dump has been materially increased. Prior to this change the harvester had to wait at the dump while thawing took place, and the can returned to the vertical position.



Then he had to wait while the can filled with water. Now thawing and filling may take place simultaneously. Cans shown are coated with oil-primed bituminous paint, which has never slowed up the freezing time in the least.

Conservation Plan for Refrigerating Engineers

VOLUNTARY conservation plans which can make a notable contribution to the Nation's wartime effort have been announced as the Refrigeration and Air-Conditioning Industry's Program for Victory. They already have the endorsement of 12 leading organizations in the industry. The Program for Victory, which specifies practical means of saving, simplifying and substituting materials needed in the war, is the outgrowth of informal conferences between Dr. William R. Hainsworth, president of the A. S. R. E. and various officials in Washington, including Henry W. Dinegar, Division of Civilian Supply, O. P. A. It is expected that official endorsement of the plans will soon be secured from leading WPB officials.

They consist of three parts: (1) for manufacturers; (2) for dealers or jobbers; and (3) for operators, maintenance men and service engineers. The pledge for the last group reads "I pledge to conserve for Victory . . . Save . . . Simplify . . . Substitute and as an operator (maintenance or service engineer) I will . . ."

1. Keep machines running efficiently and smoothly. Check performance. Conserve electricity, fuel and power.

2. Find all leaks and repair them as soon as possible. Be sure not to add refrigerant until leak is found and repaired. If necessary, remove refrigerant and transfer it to an approved container. Avoid purging to the air. Check shaft seal. Tighten gasket joints.

3. Check compressor oil level. Oil motor bearings and keep them oiled.

4. Keep motors operating efficiently. Clean commutators and brushes. Replace badly worn bearings.

5. Check belt alinement and tension. Conserve rubber.

6. Blow off condenser surface on air-cooled machines. Be sure that air supply is adequate.

7. Clean condensers on water-cooled machines. Be sure there is no partial stoppage. Be sure that the water valve is set to maintain economical condensing pressure. Clean regulating valve and strainers.

8. Check insulation for moisture, deterioration and tightness. Replace if defective.

9. Make certain that tools and equipment are in good order. Clean and check tool kit.

10. Check stock of parts, fittings and supplies.

11. Return empty refrigerant cylinders to suppliers without delay.

12. Give prompt service. Be sure of the diagnosis of trouble. Avoid guesswork. Plan work to save time and tires. Concentrate effort. Avoid repeat calls. Study service manuals and information supplied by manufacturers.

13. Check expansion valve if crankcase runs cold.

14. Remove oil from rubber mounting blocks.

15. Clean evaporator surface.

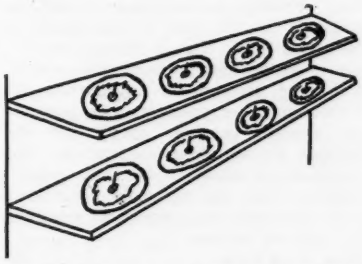
16. Advertise and publicize my ability and desire to aid in the wartime program.

17. Instruct users in procedure in an emergency.

The Recording Chart Problem

By W. F. SCHAPHORST

THIS SKETCH shows how a prominent plant solves its recording chart problem. Two shelves are arranged as indicated, slightly sloping, and at convenient height for easy reading. There are eight recorders in the plant, hence eight pegs in the shelves. The latest charts are



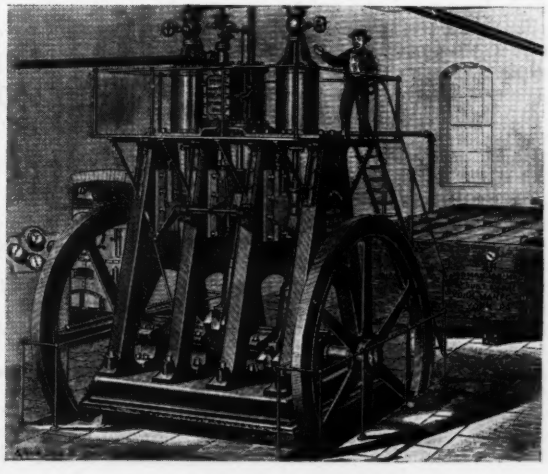
always kept on top. Each peg is clearly marked so that the charts from the same recorder are always placed on that peg. The shelves are amply wide and the pegs are spaced far enough apart so that there is plenty of clearance and no overlapping. Charts covering a full week are always kept on these pegs, previous ones being systematically filed away permanently.

* * *

Excessive head pressures can result from several causes such as: insufficient cooling water; unduly warm cooling water; scale, dirt, oil or sludge on the condensing surfaces; and non-condensible gases in the system.

Grandpa Doted on This Giant Ice Machine

Youngsters brought up on streamlined models and high speed machines have difficulty in understanding the pride and care old timers lavished on these behemoths. This 100 t. refrigeration machine built in 1885 was the first York ammonia compressor. It was designed by George Jarman and went to a packing house in Dixie. The machine, driven by the center steam cylinder at 50 r.p.m. stood 20 ft. high and used 60 times the floor space of a modern machine



Questions And Answers

Question No. 190

Ammonia Mixture and Fire Line Connection?

RECENTLY in an examination I was asked about the proper hookup of ammonia mixture and fire department Siamese connections. In our plant the mixer is connected only to the suction line. Further investigation shows no standard practice, that I can determine, but I do think that it should be connected to the high-pressure side as well. I will be grateful for any further information other engineers can give me on practice in their plants and the reasons for variations in practice. The examination angle is of some importance to me, but my main concern is to be sure our own connections conform to standard practice.

New York City J. K.

Question No. 191

Wants Help on Training Operators

WHILE the various government agencies interested in training and production have accomplished remarkable results in foremen training and machine operators' courses, the men dealing with power plant operation and general maintenance throughout the plant have apparently been entirely neglected.

Due to the tremendous turnover of manpower at this time, the personnel problem in the maintenance and operating group is a very trying one. At a time when the maintenance department's problems are more numerous than ever before, and operation is difficult because of the greatly increased output, training and educational programs seem to me to be absolutely necessary if serious delays and even accidents do not occur.

I would like to know what other companies are doing in the way of training new men and providing for adequate supervision of inexperienced men in these vital departments. It seems essential that any training course be carried on by the heads of departments themselves with only a small part at most turned over to the regular educational groups. I would like to know: If these courses are carried on during regular working hours? Are men paid for the time attending class or are they charged for attending the classes? Is it practical for one company or perhaps several companies cooperatively to organize training classes, graduation from which would be a requisite for obtaining a job in the operating department?

Pittsburgh, Pa. D. J. C.

Question No. 192

Should He Throw the Economizer Away?

FOR A NUMBER of years we have had trouble with our steel tube economizer due to oxygen corrosion. Better water conditioning eventually improved this materially and we have not had much trouble recently; however, the condition of the tubes is such that retubing is essential in the near future. The boiler is of the four drum bent tube type, 900 hp., stoker fired, with a little over 9000 sq. ft. of convection heating surface and 4700 sq. ft. of integral economizer surface. Operating conditions: 300 lb. ga. and 100 deg. F. superheat; average rating 225 per cent; water to economizer 200 deg. F.; from economizer 320 deg. F.; stack temperature 450 deg. F.; average efficiency 77 per cent.

It has been suggested that we remove the economizer entirely. Would this be practical and how would it affect: The capacity? The efficiency? The stack temperature? The flue gas heat loss?

At present the boiler is baffled for three passes with straight baffles, one on the back of the first tube bank, one at the back of the second tube bank. If the third or economizer pass were eliminated, would it be advisable to rebaffle the boiler for cross instead of the present parallel flow? How would this affect the draft loss and heat transfer?

Pittsburgh, Pa. S. J.

Answer No. 157

Checking Up On An Old Engine

DUE TO THE WAR N. Y. is considering putting back into service an old outside crank engine, reported to be out of alinement, not in very good shape and with a history of flooding the cylinder from the barometric condenser. On p. 93 of the March issue he asked for help on checking the engine over. The article on p. 90 of the August issue was adapted from a direct answer to this question. Other answers will be published subsequently.

A Hurry Up Method—With Notes on the Condenser

In answer to this question the easiest way to check on the engine alinement would be as follows:

Stretch a fine wire tightly between two standards located at opposite ends of the engine so that the line is at the height of the center of the cylinder and extending a little beyond the cylinder on one end and the crank arm at the other end. This wire should be level and 2 or 3 in. to the side of the cylinder.

A measurement should be taken from the wire to the turned head where cylinder and frame are bolted together. This measurement, plus one-half the diameter of the head, will give the distance to the center. The distance from the wire to the center of the opposite cylinder head should be the same. If so, the wire is exactly parallel to the cylinder.

If the engine has a girder frame, the measurement may be taken to the center of the stuffing box for the inside of the stuffing box has been turned. (Some engineers would merely measure to the center of the piston rod which would probably be near enough.) Figure 1 illustrates where the measurements should be taken.

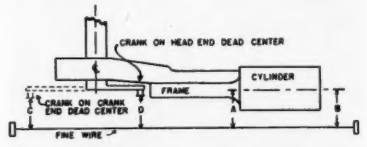


Fig. 1. Sketch showing how Mr. Hope suggests lining up the engine in a hurry

If C and D are equal the engine is in proper alinement.

If A and B are equal the line is parallel to the cylinder.

To find out if the crankshaft is in line with the engine, place the engine on one dead center and measure from the line to the face of the crank pin. Place the engine on the opposite dead center and measure again. If these measurements are not the same, the engine is out of line and the outboard bearing must be shifted until they are the same.

While this procedure will give fairly good results, I think it would be better to strip the engine, run a line through the cylinder center and proceed in the conventional way, at the same time examining all parts of the engine.

Flooding an engine when using a barometric condenser can happen and is often caused by aeration. Aeration occurs when air gets into the tail pipe and rushes through the water to the exhaust pipe, carrying with it a fine spray of water. This water can get into the engine when shutting down.

Aeration can be caused by: (1) A leak in the tail pipe; (2) too small a hotwell which allows the tail pipe to become uncovered; or (3) end of the tail pipe rusted off so that it does not protrude into the hotwell far enough.

Another cause of trouble, where a pump is used to force water to the condenser, would be a plugged or frozen tail pipé in which case the pump would force water into the engine. Still another source of trouble would be a

drain trap on the exhaust line which would not work.

This would allow water to accumulate in the pipe and then get into the engine when shutting down. The usual procedure in shutting down is to shut off steam and then shut off the injection water and open a drip for a vacuum breaker.

Right here is where the trouble occurs, for in slowing down, the engine has a vacuum in its cylinder and any accumulated water is forced into it by atmospheric pressure, coming through the drip or vacuum breaker.

Lowell, Mass. CLARENCE W. HOPE

The Conclusion of Mac's Article On Page 90 of Last Issue

WITH regard to water coming back into the engine from the barometric condenser, this does happen due to faulty installation or to faulty operation, although many times the water came from the boiler and not from the condenser. If the condenser could alibi the way firemen can, maybe the blame would be properly placed. To discuss condensers would take as much space as cracks. Why doesn't N. Y. send in a sketch showing the relative positions of engine and condenser with dimensions and distances, also the piping arrangement. Maybe the trouble could be located.

Melrose, Mass. E. MAC DERMOD.

Answer No. 162

What Determines Lead?

ON PAGE 96 of the April issue, L. B. requests advice on "What determines the amount of lead on any kind of a steam engine?"

The amount of lead varies from 0 to about ¼ in. It can be determined only by trial and the use of an indicator, generally, only enough should be given to fill the clearance space and make a smooth running job when passing centers. A safe estimate would be 1/32 in. per foot of stroke. The proper amount takes into consideration:

Size and speed of engine.....
.....More lead to high speed engine
Valve design....More lead to slow valves
Noise level.....Proper lead, quiet job
Economy..Too much lead, negative work
Too little lead, power loss and noisy operation.

Cincinnati, O. WM. E. RIXMAN

Agrees 1/32 in. per Foot is a Good Start

LEAD is given an engine valve to increase the economy of the engine by establishing full header pressure on the piston head at the instant of reversal (giving a larger work area on the card) and is also used as a means of bringing the reciprocating parts to an easy, cushioned stop by opposing the final few inches of travel by the full header pressure.

Therefore, it is obvious that the amount of lead is determined from the header pressure, and the mass and velocity of the reciprocating parts of the engine.

As a starting point, 1/32 in. per foot of piston travel can be tried. In vertical engines, slightly less lead is given the head end valve because the upward movement of the reciprocating parts is also opposed by the force of gravity. When striving for a quiet, economical engine, correct lead is of great importance.

SAM WILLIAMS

Answer No. 175

Ed's Engine Works Down But Not Up!

SORRY but space this month does not permit winding up the little tiff Mac and Ed had over the mysterious indicator card (p. 95 June and p. 95 August issues). Take the editor's word however that it's good and worth waiting for—2 pp. with illustrations and a new trick card that's a Lulu!

Answer No. 184

Substitute Materials

THIS SUBJECT is a trying one at the present time and with critical materials changing constantly from time to time no permanent solution is likely to be found. On p. 100 of the July issue R. K. said he was facing trouble over the replacement of a large number of chromium plated pump rods and also bronze sleeve bearings.

The following reply may in some cases be helpful and in others not. Reports have been received that is is difficult if not impossible to get outside shops to grind metal sprayed parts and few plants have the grinding machines available themselves.

While the harder surfacing is desirable, engineers will in many cases have to be satisfied with shorter life materials. Old pump rods can be turned down for next larger size pumps with a great saving in materials. Many machines formerly designed for a life of 12 to 15 yr., are now being intentionally designed with a 3 or 4 yr. life in mind. On maintenance problems engineers should keep this in mind.

At the end of that time materials now on the critical list will be plentiful, or Mr. Hitler will be doing the worrying about replacements. This is definitely no time to worry about how long a thing is going to last—the problem is to keep it working temporarily even though the same thing has to be done over in another 6 mo.

Sam Says Try Metal Spraying

A RAPID and economical solution to R. K.'s problem is for him to re-surface the bronze sleeves and chromium plated pump rods by the metal spraying process. Comparatively little new metal is used, and most of the expense will be in machining.

It is also suggested that R. K. look into every possible means to prevent undue wear on the parts. Perhaps a change of lubricant and/or packing will help. SAM WILLIAMS

Answer No. 185

His Exciters Hunt

OPERATING three engine generator sets, 1850, 526 and 150 kv-a. in parallel, W. R. has difficulty with the exciters hunting. On p. 100 of the July issue he asks readers for a possible solution of the problem.

Reduce the Voltage or Use the Largest One

AN ACCURATE answer to W. R.'s exciter problem is not possible as so little data is given. A general question demands a general answer. The manner in which the exciters are driven and the method by which they are wired will have a profound effect upon their operation.

Are the machines belt driven, or direct driven, from the main units, or are they separately driven? Are they operated in parallel, or is each alternator excited from its own individual exciter? And what make and type of voltage regulator is used?

We suggest that W. R. look into the matter of speed regulation of the exciters. Slapping and squealing belts would indicate trouble of that nature. The remedy is obvious.

Check the exciters carefully for mechanical-electrical defects such as sticking brushes, eccentric commutator (check when hot from running) and dirty or loose connections in the equalizer circuit.

Check the voltage regulator for correct adjustments, then clean all contacts, and moving joints or bearings.

Exciter voltage has a distinct effect upon the operation of the machines. If these exciters operate in conjunction with a voltage regulator, it is suggested that they be operated with as low a voltage as possible. This is done by cutting out the main field rheostats. However, to eliminate cross currents between the alternators, it may be necessary to manipulate the rheostats to some extent. Set the rheostats in the position that gives the least total current output of the alternators in parallel.

If the exciters are operated with manual voltage control, run with exciter voltage not less than 50 to 60 per cent of rated exciter voltage. And, if nothing shows up as a cause of the trouble, try operating the units from the largest exciter. This can often be done without undue overload. SAM WILLIAMS

Answer No. 187

Slag and Spalling Mean High Furnace Maintenance

ON P. 100 of the July issue H. G. K. said: "Costly furnace maintenance has been bothering us for some time due to high constant overloads (200 per cent) and low fusion ash coal which gives us a bed of hot syrupy stuff that causes undue spalling of our furnace walls. Replacing spalled brick in a wall 19 ft. long, 19 ft. high and 12 ft. wide is quite an expense, to say nothing of the enforced outage. We would like to install water cooled walls, but can't take the time out even though we could

get the tubes and headers. Any tips on operation, air cooling or different type of brick which would help us would be appreciated."

Larry Hits the "High Spots"

As is usual with furnace problems, this question has so many variables that hundreds of answers could be given which have corrected other engineers' troubles of this kind and these solutions would still not solve this particular problem. So in order to prevent the trying out of many suggestions which would not help this situation, I think we should try to analyze generally the causes of such a condition.

High overloads for this particular type of boiler are probably the cause of the trouble, but nowadays we have to carry these overloads and, although 200 per cent rating is not generally considered excessive, under some conditions it may be extremely so.

The reason for the high furnace temperature is because the fuel bed is releasing the heat in the furnace faster than the boiler can absorb it and I assume forced draft under tuyeres or grates is being used. In such a case, a balance or plus draft probably exists in the furnace to such a point that no more air could be forced under fire without being blown out the doors and openings and cracks.

In such a case, while water cooling would correct the refractory maintenance problem, it would not allow more air to pass through the fire to burn the additional coal needed to carry heavier loads.

This pressure condition in the furnace can only be relieved by an increase in stack and furnace draft by: Increasing stack height or draft; keeping flues or tubes clean; stopping air leaks; closing dampers on idle boilers; or reducing heights of baffles or bridge walls, etc.

To allow the gas and heat to pass from the furnace to the boiler will allow more air to pass through the tuyeres or grates (all other things being equal). This will keep them and the ashes cooler, burn more coal and make more steam although not as efficiently because the stack temperature will rise.

If the condition above referred to is caused by tubes being stopped up with slag, which makes, or starts, the balanced or plus furnace draft, and, as long as these tubes are clean no trouble is experienced, then fuel and fuel bed troubles should be analyzed.

Segregation problems in coal handling equipment causing unequal distribution of sizes in the fuel bed. This will cause spotty burning (high burning rates in the spot the nut coal is and 'dead spots' or low burning rates where the fines increase resistance to air flow). This means high velocity burning in the hot spots and excessive blow overs into the tubes. If the dead spots are broken up to carry load, the molten ash formed by stirring ash into the fire will be lifted by high velocity burning and carried into the tubes.

Under such a condition, coal selection as to improving size consist, and redesign of coal handling equipment to prevent segregation, will help. If not enough relief is obtained for your particular condition, changing to a higher fusion point coal may help your new conditions if it is economically practical.

In writing at such length which after all only touches the 'high spots', I have mentioned just a few conditions which may cause your trouble. I would suggest that a capable fuel engineer be contacted who can inspect your plant in your company and with your help determine just what conditions are the cause of your difficulties. Then you can decide just what should be done practically to correct the situation.

I have not made any suggestions as to change in refractory as, in my opinion, this would not correct the causes. It might not be possible to correct the causes of your trouble and if such is the case, a change in refractory to a higher fusing carborundum brick might make your refractory maintenance conditions better.

Air cooling of refractories if applied in such a manner to aggrevate the balance or plus furnace draft might make your conditions worse, for if applied to preheat primary air it probably would increase stoker casting maintenance and aggravate clinker trouble.

Larry A. Shipman
Combustion Engineer
Southern Coal & Coke Co.
Knoxville, Tenn.

Answer No. 189

Should the Heating System Be Drained?

This question was asked by J. Q. R. on p. 93 of the August issue. He referred specifically to the non-heating season when the pipes may be drained or left full of water. He also wanted to know why—regardless of what the answer was.

The Answer Is—Very Definitely—NO

When a hot water heating system is drained, the water in most cases will be somewhat dirty and may even carry with it appreciable amounts of sludge. This observation leads many people to the erroneous conclusion that hot water systems should be drained at regular intervals to prevent them from being damaged by corrosion or becoming clogged with mud.

While the heating system is new, it is advisable to flush it out once or twice for the purpose of removing foreign matter and dirt that invariably are present in new pipes, radiators, and boilers. The circulation of the water will carry most of this material down to the boiler, whence it can be removed by draining and flushing. After that, the system should be refilled with fresh water and no further draining should be necessary unless there are leaks in the piping, or unless the house is unoccupied during cold weather.

Once a new hot water system has been cleaned out, the subsequent formation of sludge in the system is due to two separate causes: One is the fact that fresh water practically always contains bicarbonates, known as temporary hardness. These bicarbonates gradually break down, when the water is heated, and form carbon dioxide and a muddy precipitate that may or may not remain suspended in the water. This depends upon the amount of circulation and other factors.

Since in a closed system, at one time or another all the water comes in contact with the hot surfaces of the boiler, it is evident that the process will continue until in time all bicarbonates in the water have been broken down. Evidence of this occurrence is found in the fact that air will continue to collect in some of the radiators long after the original air in the system has been completely expelled.

This air is in reality a mixture of carbon dioxide, dissolved oxygen expelled by the heat, and probably some hydrogen, the latter resulting from corrosion. When the breakdown of the bicarbonates contained in the water has been completed, the formation of carbon dioxide and sludge from this source must of course come to a stop.

Another factor responsible for dirty water in a heating system is corrosion. Fresh water, unless it be very highly alkaline, will (by way of free hydrogen ions) gradually dissolve iron, forming $Fe(OH)_2$, ferrous hydrate. This in turn combines with the dissolved oxygen, invariably present in fresh water, to form ferric hydrate, commonly known as rust. These are two distinct chemical actions, the continuation of which depends upon the supply of free hydrogen ions and oxygen contained in the water.

Inasmuch as ferrous hydrate does not discolor the water or precipitate out, it may be stated that the presence of dissolved oxygen alone is the controlling factor in causing rust. As the supply of oxygen is definitely limited in a closed heating system, it is evident that the rusting process will be arrested as soon as all the available oxygen in the water is used up.

Thus it is seen that sludge formation, due to both bicarbonates and corrosion, will automatically stop as soon as the water has become deactivated on both counts. On the other hand, if the system is periodically refilled with fresh water, or if there are leaks requiring fresh make-up water to be added from time to time, the formation of sludge will start all over again every time.

The amount of sludge or turbidity formed in any hot water heating system depends on the original character of the water, on the temperature, and on the size of the heating system. In most cases, it is not sufficient to cause any harm if left in the system indefinitely.

Old Bridge, N. J. A. J. Lubeley

Problem 23. Our Hero Tackles a Meat Packing Plant — With Some Success

How Would You Do It?

VISIBLY SHAKEN by newspaper reports of a possible meat shortage the Judges quickly got down to cases on Problem 23 for, said the Senior Judge, "With Congress determined to sabotage the rubber program, rubber bones next year will be at a premium. Millions of dogs must be supplied with the real thing or face a straight diet of dog food. We must do our best to see that not a butcher shop closes its doors—that not a single packing plant operates at reduced capacity—certainly not a Memphis plant—Why, when Grandpap and I fit' with Hood——."

It seemed for awhile as though the Judges were going to fight the Civil War all over again, so Our Hero and his Dixie friend reviewed their own Battle of the Junk Pile. His friend, an engineer in a small packing plant, was having trouble carrying peak loads, yet was wasting exhaust steam 18 out of 24 hr.

As a start an underground cistern was converted to a hotwell for the warm water from the ammonia condensers. Then an old H.r.t. boiler was converted to a closed heater and a steam pump hooked up as a circulator. The 4-in. steam line was disconnected from the header and used for the hot water line to the various departments, with a small direct line back to the heater to maintain circulation at all times.

When exhaust steam is being wasted, this return is diverted to the hotwell. Thus there is always a heater full of hot water and a greater reserve of warm water in the hotwell which was kept full at all times by a small make-up pump. Existing cold water lines and live steam mixers were left intact so, in case of necessity, live steam can be quickly piped to any department from the 2½-in. live steam line which was left in place.

Furthermore, they planned ahead a bit for the days when new equipment may be purchased. They figure that with a high-pressure boiler, an extraction-back pressure turbine, and a motor drive for one of the compressors an arrangement such as shown by Fig. 1 will be quite practical. This will give four steam pressure systems, 450, 150, 60 and 3 lb. ga., and with the old steam driven machines give a means of balancing steam and electric loads to avoid waste of exhaust steam.

While the Judges did finally get down to business and settle the contest in record time it was a tough job because everyone seemed to have the same general idea. Perhaps the solution was too obvious and general, for as one contestant points out, the problem, while dealing specifically with a packing plant, is fundamentally the same one encountered in any plant using considerable quantities of process steam.

In awarding the prizes the Judges drew attention to: The simplicity of the suggestions in the First Award, the direct application to, and the familiarity with conditions of the problem in hand; and the wide scope and detailed suggestions of the Second Award, which while directed at the specific problem are in these times worthy of close study by all users of process steam. The Third Award, while written by an engineer of experience and equal in scope to the others, is less detailed and more in the nature of an outline.

FIRST PRIZE AWARD
G. F. Suchy
West Fargo, N. D.

SINCE this plant experiences difficulties in water treatment besides lack of boiler capacity, one of the most essential arrangements would be a closed type water heater. The water used for packing house process work needs to be heated, but not conditioned, so the closed type heater is satisfactory. The process water, for a meat packing plant, requires a temperature of only 110 deg. F., excepting the hog scalding tub water which requires 140 deg. F.

At 110 deg. the water does not impart any appreciable incrustation. The condensate from this heater would then be added to the boiler feedwater together with condensate from melters, percolator pans, dryers, jacketed kettles and various radiators. This would improve the feedwater, both from the standpoint of chemical and heat conditions.

A continuous blowdown line from the boilers should be connected directly into the hog scalding tub. After each day's kill the tub is drained, flushed and the drain valve closed so that the blowdown water can accumulate. Some make-up water may have to be added. The chemical condition of boiler blowdown water is essential in the hog scalding process. Most of the heat is retained in this arrangement thus reducing to some extent the peak load on the boilers.

Exhaust steam which is being wasted during the off peak 18 hr. could be diverted through an atmospheric condenser over which would flow the water from the ammonia condenser. Any condensate gained in this manner would then be stored as for boiler feed make-up water during the peak hours. The raw effluent from this condenser would be pumped, from the sump below, to the plant process water system such as the water heater mentioned in the first paragraph, the spray water in the holding pens, stock truck washing, and for boiler feed make-up water. Cold water would be used only for ammonia condensers, miscellaneous cooling vats, or sprays, and for drinking fountains.

SECOND PRIZE AWARD
Barry M. Turner
Ticonderoga, N. Y.

THIS problem of our Hero's friend is not an uncommon one in almost any processing industry. Without specific knowledge of the plant in question, the following suggestions are offered our Hero in order to help him come through. As I understand it, the source of worry confronting our friend is: (A) lack of boiler capacity during peak loads; (B) excessive fresh water make-up; and (C) excessive exhaust steam for 18 hr. per day.

If we assume that excess exhaust steam exists during the peak load period and the amount wasted is enough to relieve the load and feedwater condition, it is readily seen that by eliminating the exhaust steam excess all three conditions are corrected.

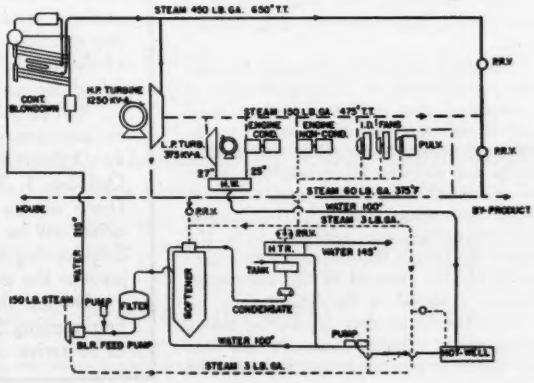


Fig. 1. Diagram showing how one packing plant handles the water heating problem with exhaust steam and full recovery of heat from the ammonia and steam condense s. Provision for balancing the exhaust steam and power is made in connection with steam driven and electric driven refrigeration compressors not shown in the above diagram

Hence the first point to check is the source of excessive exhaust to determine if there is any unnecessary waste such as available condensate not returned to the feedwater heater, high-pressure traps blowing through, poor valve settings on engines, pumps, etc., poor or worn cylinders, valves and piston rings.

This would not only involve a check on prime movers but also on the equipment they drive. For example, a faulty refrigeration system would cause excessive exhausts from the engine drive to produce the desired results. Frequently some headway can be made in steam economy by following the above procedure; however, equipment has to be in really poor condition to make the difference assumed.

If, after thoroughly going over the equipment, it is found that no progress has been made in eliminating the exhaust steam, or that there is still too much for comfort, the following should be explored: (1) find a use for exhaust steam where live steam is now being used; and (2) arrange for the purchase of electric power to drive equipment now driven by steam.

Let us first explore Item No. 1. Since there is a large quantity of process and washing water heated by live steam, it would be logical to use the exhaust steam to heat this water. The exact lay-out of equipment will depend largely on equipment on hand and that obtainable. If a direct contact heater is used, some storage must be provided, also control equipment to keep the water at the desired temperature, and maintain the water temperature during the time no exhaust steam is available; also, float valves to maintain water level in the storage tank.

A pump will also be necessary to get the water to the different departments at the desired pressure. If this pump is steam driven it must be realized that the exhaust from it is adding to the amount to be absorbed and the degree of success of the venture will depend on the relative amounts of live steam used for heating water and the amount of total exhaust steam.

Should the system become balanced or require some live steam make-up, the requirements have been satisfied plus a nice saving in the fuel bill. Incidentally, the cooling water from the ammonia condensers could be run to the heater if uncontaminated and heat balance is such that it could be used to an advantage.

Should a closed or coil heater be used, the pump could be eliminated since it is assumed that the service water pressure is sufficient to get the water to the different departments. Sufficient control equipment will also be necessary in order to maintain water temperature. By using the exhaust steam in this manner the conditions are satisfied with the added advantage that fresh water make-up is further reduced in the amount of steam condensed in the heater.

In either case, care should be taken, when using exhaust steam, to see that the water to process is not contaminated with oil in the contact heater setup and that the heater condensate returns to the boilers is not likewise contaminated if the coil heater is used. A properly designed and installed oil separator will adequately take care of this. Attention should also be given to the type and amount of oil used for cylinder lubricating purposes in order to keep the oil to a minimum in the condensate.

Whether or not exhaust steam could be used in place of live steam in any other process will depend on the steam pressure used in processing and that in the exhaust header.

Now let us investigate reducing the exhaust steam by installing electrically driven machinery to replace steam driven equipment and buying electric power. In most localities, electric power can be purchased at considerable saving over an equivalent amount of steam power when the steam equipment exhausts to the atmosphere. In making a change of this type, great care should be exercised and it is usually confined to pumps and small machines and auxiliaries. It has a great advantage of having standby equipment in case of unforeseen breakdown and also provides flexibility with respect to the heat balance.

Equipment usually would have to be purchased new—and our friend may experience difficulties just now, priority regulations being what they are. Thus the substitution of electrically driven equipment for enough steam equipment to reduce the excess exhaust would satisfy the conditions as follows: Reduce the peak load and total steam generated; eliminate excessive exhaust; and reduce make-up water by the amount of reduced steam loss. There would be a saving in steam cost, but an added expense of purchased power.

All of the above has been based on the assumption that the excessive exhaust occurs during the peak period. If this is not the case, our friend had better contact the management and explore the possibility of staggering operations in such a way that the peak loads are ironed out after making sure there is no unnecessary steam consumption. If this does not produce results,

$25 PRIORITIES PRIZE CONTEST—TWO PRIZES

NO BOTTLE TOPS, no cartons, no coupons and no jingles! Just two $25 War Bonds waiting to rustle in someone's pocket in exchange for a few minutes time and thought on two very pressing current problems: (1) emergency repairs or maintenance; and (2) priorities.

One bond worth $25 at maturity will be given in each of the following two divisions of the contest.

DIVISION ONE: For the best example of emergency repair, maintenance or increased capacity of present equipment (in either an industrial plant or central station). Entries will be judged on: (1) ingenuity; (2) maximum use of materials, machine tools, equipment and labor available in the plant; (3) minimum use of critical materials; (4) minimum interference with production; and (5) value to the plant in question.

DIVISION TWO: For the best statement of the PROBLEM presented by current priority regulations and material restrictions to the engineer in connection with the maintenance, continued operation or expansion of power and steam services. For purposes of judging, entries will be divided into four groups operating under somewhat different conditions: (A) central stations, (B) manufacturing plants completely or almost completely engaged in war work or filling Army, Navy or lend-lease orders, (C) manufacturing plants with little or no war work, (D) service institutions (schools, hospitals, laundries, etc.) Entries should indicate the group referred to but company names and plant locations will not be published. Entries will be judged on the evident appreciation of the problem displayed and the degree of reasonable responsibility placed upon: the individual engineer; various government agencies; and other departments of the plant. The award will be based solely on the presentation of the problem, but where reasonably workable solutions have been evolved (and this is all that can be expected in these changing times) the solution of the problem should also be included as a separate part of the entry. A solution accompanying the winning award will, if published, be paid for extra at regular rates.

RULES ARE SIMPLE. Entries should not exceed 1500 words but may be supplemented by photographs or drawings if you wish. Any reader may submit one or more entries which must be in the office on or before October 1. Editors will serve as judges and their decision will be final. There will be one prize in each division, but in case of a tie duplicate prizes will be awarded. All entries become the property of Power Plant Engineering subject to publication in the magazine. All entries published (except the prize award entries) will be paid for at regular rates.

Entries should be addressed to the Contest Editor, Power Plant Engineering, 53 W. Jackson Blvd., Chicago, Ill., and should be mailed so as to arrive on or before October 1.

$H_2O+?$

When Noah looked out of the ark after forty days and nights of rain all he could see was WATER that covered the earth—H_2O!

This water was practically pure H_2O, but in seeping thru the earth to form the present day sources of feed water supply, it accumulates various plus polutions which must be eliminated before using.

The Nalco engineers see every source of feed water supply as a challenge which calls for individual analysis and treatment to prevent damage and destruction to expensive plant equipment.

Let Nalco engineers make a survey of your water supply—they will recommend a treatment that will solve your problem.

Write today—no obligation.

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in order to correct the peak load problem, additional capacity will be necessary.

Of course, it is assumed that the boiler plant is in good condition and is efficiently operated. This additional capacity would solve only the peak load difficulty and in order to eliminate the others, one of the steps as outlined above would have to be taken.

Thus we find that an adequate solution to the problem of our Hero's friend requires some detailed knowledge of the plant and its operation. If our Hero wishes to avoid being called names it is suggested that he catch the first train to Memphis and do a bit of investigating, then apply the analysis as outlined above. He should then, without much difficulty, be able to suggest a solution.

THIRD PRIZE AWARD

Leon Hawkinson

Everett, Wash.

YOUR birdseye view of the troubles were rather hazy; however, I have had packing plant experience and wish to make these recommendations, assuming, of course, that they are not already in use. They may, however, already be in practice.

1. Superheaters on boilers. In case of water tube boilers this would be easy and even with an H.r.t. it is not difficult.

2. High-pressure, recirculating hot water system. This could be heated in a regulation heater with exhaust steam. The high pressure (150 to 200 lb.) will cut grease and the recirculated hot water will finish the cleaning with the hoses.

3. Indirect process heating. This may be utilized with cooking vats, scalding tanks, knife buckets, cleaning and washing tanks and all equipment now being heated by live steam jets which should be replaced by steam coils wherever possible.

4. Ammonia condenser heat may be reclaimed and utilized in the feedwater or process water.

5. Proper insulation. All piping should be checked for heat losses. Packing plant insulation is subject to excessive humidity and is likely to be soggy and inefficient.

6. Staggered hours. If possible the supervision of the plant should stagger working hours so that peak loads would not synchronize.

Letters And Comments

He Does Not Think Our Units Are Nuts

ON PAGE 86 of the June issue is a rather brash prediction that "the United States will some day fall in line and adopt the metric system" for "the handwriting is on the wall."

There have been periodical attempts to force the metric system upon the country by people with far more zeal than sense. If the metric system has the advantages claimed, it would seem that it would be adopted from sheer force of worth. As a matter of fact, its use in the so-called metric countries is by compulsion—bureaucratic coercion.

It does not seem possible that anyone familiar with manufacturing and trade, would invite the cataclysm that would follow the adoption of the metric system. One might, as a beginning, consider the effect on machine tools and small tools, jigs, fixtures and dies; then take the thousands of articles that have been standardized on the English system of measurement.

Then ask onesself if the billions of dollars that would be expended in making the change would be justified by the adoption of a system of measurement, actually inferior to the existing one, and which, in the minds of most of the proponents of the change, is confused with a decimal system that antedates the metric system by centuries.

Los Angeles, Cal. C. O. SANDSTROM

History Repeats

IT IS always interesting to see history repeat itself. On p. 108 of the July, 1942 issue, Fig. 2 of Welding Tricks shows a newly developed method of removing stud bolts.

Reference to the welding encyclopedia, third edition of 1923, shows a modification of this scheme on p. 139 in which the weld metal is built up from the bolt and filed square for removal. I think several articles in the General Electric Review between 1914 to 1918 will show the exact method rediscovered by Morton and Kramer.

It was generally used in the Schenectady plant of the General Electric Co., the trick having been discovered that time as I remember by a Belfast Irishman who for quite a while was the only arc welder in the plant. This method was not only used for broken stud bolts but was used for the removal of broken taps which is much more difficult.

St. Louis, Mo. H. L. UNLAND

Why Do They Quit?

MR. FAULHABER'S letters (p. 104, April issue and p. 86, June issue) call attention to one of the many phases of personnel management. Oddly enough, the conditions bewailed in his June letter are often the result of the situation outlined in the opening paragraphs of the April article.

Here we see, in April, a benevolent Chief, fighting manfully for the promotion of his assistant. Now, in a great many cases, that same assistant is a brother, son, cousin, or some other relative. It is interesting to note that often this relationship extends to that of the barnyard variety, and all of the Chief's fiery partisanship is displayed merely to insure the continuation of the regime in power.

Coal passers and oilers are not the only class of employes who move frequently; all to often, competent engineers resign too frequently. It would be exercising poetic license to a fantastic degree to compare a horny handed engineer with Galahad in search of the Grail, but EVERY worthy engineer is in search of his own personal Grail in the form of a place to work where industry, competence and honesty are valued, and promotion based upon those virtues.

What engineer has not accepted a position with the Traveling Electron Co., or one of its contemporaries, and, full of hope and sincerity, has plunged into his work with vigor and competence, only to find in a short time, that every avenue to promotion is blocked, that every path to progress or a decent post is unavailable, because of the presence of a member of the Royal Family, or one of its satellites.

He finds his subordinates difficult to discipline, because they are fully aware of HIS insecure position. He finds difficulty in establishing a good record as regards his work, as every print, every descriptive booklet, every helpful scrap of printed matter is under lock and key. He is not furnished with a key.

He is ignored in every conference on plant operation, or policy, and of course, blamed for every trouble. He is a convenient, if unwilling kicking post. After having the temerity to offer a constructive suggestion, (curtly rebuffed) he sees the futility of it, and says no more. After a comparatively short time, he becomes disgusted, and seeks employment in farther fields. In time he may or may not find his niche.

In addition to the adverse effect upon the plant personnel, nepotism will have a profound effect upon the economy of the company practicing such a system. Nepotism is very productive of red ink. The writer has in mind a parent company that in the last 15 yr. nearly succeeded in stamping out this practice in its subsidiary companies.

Of late, however, due to lack of man power (they have not really tried to obtain competent help) a degree of nepotism has crept in. As a concrete example of the evil results of this entry, we point to a certain hydro plant that recently operated an entire shift at half capacity for an entire watch.

It seems that the rack man, a scion of the Royal Family, would not stoop to such laborious endeavor as cleaning trash racks. In times like these, such an occurrence is truly an economic, if not a treasonable, crime.

SAM WILLIAMS

FOR MANY SERVICES THESE IRON BODY VALVES WILL SERVE AS WELL AS BRONZE

Fig. 1640

Fig. 1640 "KING-CLIP"—a sturdy iron body gate valve with internal working parts of bronze, for hard and continuous usage. It has wide application in industry and in many cases will serve as well as a bronze valve.

Fig. 1021

Fig. 1021 "FERRENEWO"—an iron body bronze mounted globe valve for numerous services. All parts are renewable and the seat and disc are easy to regrind. An excellent valve with low upkeep.

—and with proper priorities, you are likely to get better deliveries . . . . .

The availability of bronze valves is becoming an increasingly critical problem, because of the scarcity of copper, tin, and other vital materials necessary in their manufacture.

We recommend consideration of these iron body "King-clip" gate and "Ferrenewo" globe patterns as alternates.

Since virtually all materials used in the manufacture of valves are on the list of critical materials, valve users are urged to furnish the highest possible preference ratings and proper "end use" Allocation Classification Symbols on their orders. This will be of mutual helpfulness.

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THE LUNKENHEIMER CO.
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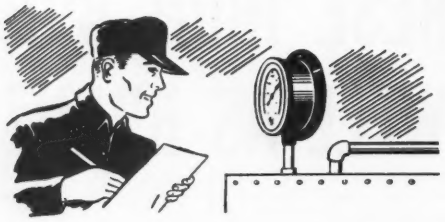
LUNKENHEIMER VALVES

How To Make Pressure Gages Last Longer



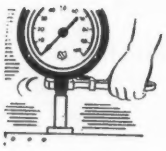
Don't treat gages like a piece of ordinary plumbing. They are instruments, and should be handled with as much care and precaution as a watch

By J. V. TRACY
Ashcroft Gauge Division,
Manning, Maxwell & Moore, Inc.

AT PRESENT, acquiring new equipment is difficult, and it frequently takes a long time to get delivery on replacements. Following is some practical advice in making your pressure gage equipment last longer.

Selection

Use gages of a range twice that of the working pressure; selecting the nearest standard range to make this possible. This will make the gage last longer, and the pointer will be in a more readable position.

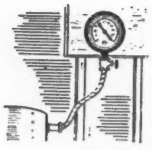


Use gages of proper internal construction and a tube material tube joint intended for the service. The slightly higher original cost will be more than compensated for because of the longer, trouble-free service life. Get the right gage for the job.

Get a good pointer and save time when making simple recalibration adjustments, such as making the gage exactly correct at the particular pressure point in which you are most interested.

Use a good grade of plastic dials, which are easy to read, easy to clean, and rust and corrosion proof.

Installation



Don't screw the gage into piping by using the gage case as a wrench. Use a pipe wrench on the wrench flats which are provided on the gage socket. When a fitting is being screwed onto the gage, hold a wrench on the socket flats, instead of twisting against the gage socket screws which are intended to hold the gage mechanism in the case.

When the gages are wall or panel mounted, make sure they are connected up free from piping strains. Check to see that mounting surface is flat or use washers under case flanges to obtain three-point suspension. Preferably, the last length of piping leading up to the gage should be flexible tubing. This will insure that the gage is free from strain.

Mount gages where they will be free from the effect of mechanical vibration. If a gage is on a badly vibrating machine, try to mount the gage on a wall nearby and connect by flexible tubing. Also mount gages where they will be free from moisture and corrosive fumes, if possible. Ordinary cases are not intended for severe conditions. Where these are unavoidable, ask for special recommendations, and in general, use plastic cases, which are resistant to most corrosive fumes and cannot rust.

Don't locate gages where they will be subjected to high heat. Undue heat weakens the soldered tube joints which are used in ordinary gages. Also, high temperatures make gages inaccurate. Always use a siphon for steam applications, and make sure it is filled with water before installation.

When the system is subject to occasional vacuum, provide a leg of piping which cannot be emptied by the vacuum effect. A drain cock or plug should be installed at the bottom of this leg, to enable occasional cleaning out the sediment. The head effect of this piping leg should be compensated for by resetting the pointer. When the gage is equipped with an adjustable pointer, this can be done without removing pointer from the movement shaft.

Protect the gages from rapid pressure fluctuations by using dampening means such as throttle screws, or needle valves; which can be adjusted to the exact orifice required.

Proper Use

Apply pressure slowly. Don't open the gage cock or valve too quickly—this imparts a severe strain on the Bourdon tube which may rupture it, or result in shortened life. When the service itself is subject to sudden pressure applications, use a needle valve, or a special gage saver.

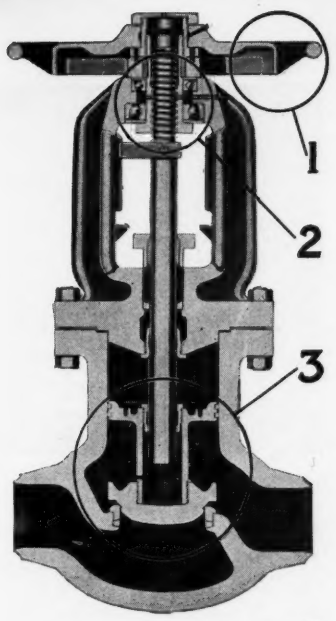
Sudden pressure release has the same detrimental effect, and should be compensated for in the same manner. On hydraulic presses a slotted link should be specified.

Avoid overpressure. See that apparatus is provided with relief valve, and that the gage range is higher than the set pressure of the valve.

Maintenance

Replace broken glasses and thus keep dirt out of the working bearings and the teeth of the movement mechanism.

Never oil gage movements or linkages. It attracts dirt, and becomes gummy; thus causing the gage to be sluggish and inaccurate.



1 For quick emergency operation and fast, drop-tight closure during boiler tests, no device is so effective as the famous Edward patented Impactor handwheel.

2 Edward's exclusive EValthrust ball bearing yoke construction. Double combination angular-radial ball bearings aid in easy valve operation.

3 Hour glass disk piston assembly gives maximum flow area above as well as below the disk. Internal body contours minimize turbulence.

(Valve illustrated has welded-in Stellite seat, welding ends)

Four giant Edward welding end non-return valves for 1500 lb, 950 F service, each equipped with Edward Impactor handwheel. A sharp turn of the wheel delivers equal sledge-hammer blows against opposite ends of cross arm.

Low Pressure Drop . . . FAST, SURE CUT-OFF . . . THAT'S EDWARD NON-RETURNS!

Good non-return valves start with sound bodies and bonnets. Typical of Edward care is the continuous use of radiography to inspect castings. This is but one of many tests Edward castings must pass. Temporary test flanges are machined off after hydrostatic test.

Edward non-return in outdoor service in southern refinery. Rugged Edward valves stand hard external as well as internal service.

IN NON-RETURN VALVES the two most important things are free flow with low pressure drop, and fast, sure closing action in emergency. Edward non-returns excel on both counts.

Streamlined internal contours, without eddy-producing spiders and disk cages, cut pressure drop to a minimum. Yet Edward cast body ribs maintain three-point guiding to keep the disk in proper position to enter the seat at all times. The distinctive Edward "hour-glass" disk-piston assembly leaves steam free to follow the easiest route to valve outlet without undue turbulence.

Edward's patented Impactor handwheel and EValthrust yoke bushing make fast valve operation in emergency or for boiler hydrostatic tests unusually simple. No other device is so effective.

Edward non-return valves are built for 150 to 1500 lb service with flanged or welding ends. Hard surfaced, integral "Intex" seats available.

THE EDWARD VALVE & MFG. CO., INC.
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EDWARD *Steel* CAST AND FORGED **VALVES**

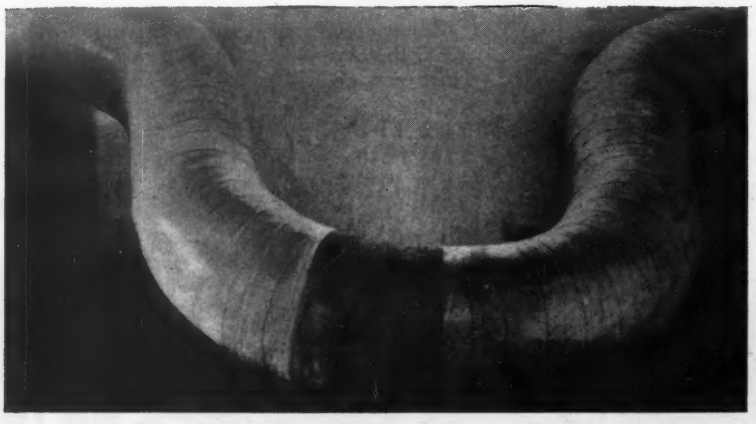
SHOP TALK

A department showing by means of photographs how engineers in various plants have overcome certain obstacles or devised methods to facilitate operation. If you have done something along similar lines that you are proud of or which you feel may be of interest to others, send us a picture and a paragraph of explanation. If the photograph is good and if the idea is original we will present it on this page and pay you for it.

BEARINGS. Frank R. Harp, superintendent of the Kerckhoff Power House (Pacific Gas & Elec. Co.) on the San Joaquin River in California, lends a hand while W. O. Anderson, machinist, wields the sledge hammer. They are installing Micarta strips on a water wheel guide bearing. Substituting Micarta for lignum vitae, a tropical wood, increased the bearing life from 3½ to 14 yr. Lignum vitae was replaced on the average of once every 3 or 4 yr. after the original clearance of 0.015 in. had been increased to 0.050 in.

Micarta is installed with a clearance of 0.009 in. and during the past 4 yr. the bearing wear has averaged 0.0025 in. Since 0.050 in. is considered the maximum allowable clearance, it is expected that the Micarta will last 14 yr. or about 4 times as long as lignum vitae. Changing a bearing involves a labor cost of approximately $100 and a loss of 20 hr. in power generation.

FIBERGLAS TAPE FOR PIPES. Announced by the Owens-Corning Fiberglas Corp., Toledo, O., spirally wound fiberglas tapes are now used for covering insulated piping. The tape is applicable to straight runs, bends, fittings and flanges, and, its loose weave affords a movement of the yarn on itself which enables the material to conform to the shape of the pipe as the tapes are applied, making it unnecessary to resort to any practice other than straight round and round spiral wrapping. The pipe is then painted with lead or oil or aluminum paint which works through and cements the material to itself at the overlap and insulation, preventing unraveling or running in case of any injury to the pipe.



BRAZING SAVES TIN. To save at least 4 t. of tin a year by eliminating the use of solder in the construction of electric motors and generators at the Westinghouse Elec. & Mfg. Co. East Pittsburgh Works, this workman no longer uses solder, a tin consuming process, for connections in this 432 wire electric motor. The ends of the copper wire are clamped together and brazed using a phos-copper strip.

HOMEMADE CONVEYOR. Four cents of electricity replaces four men. Walter Rhodebeck, young farmer-member of the Morrow Rural Electric Cooperative, Inc., Mount Gilead, O., got rid of a backache and a sizeable labor bill to which he had been subjected yearly at potato harvest time by constructing a potato conveyor. His yearly supply of potatoes, 1500 to 3000 bushels, were stored in an old basement which was a splendid storage place except for one drawback at selling time. It took four men 2 hr. each to haul 100 sacks of potatoes up a long flight of stairs to a waiting truck. Since manufactured conveyors were too expensive, he built his own. With two 23-ft. lengths of angle iron for a base, he fashioned steel metal sides forming a trough, then mounted pulleys on an endless conveyor belt. At the top of the conveyor he mounted a ¾-hp. motor which is geared to and drives the belt. The cost of material used in building the conveyor was $60. Now, one man in the basement loads the sacks on the belt and the conveyor delivers them to the arms of the truck driver.

Unfailing Power Forges Speedier Victory

Continuous operation . . . no breakdowns . . . 13% saving in lubricant cost . . . with SOLNUS OILS

Massive forgings for fighting ships . . . smaller forgings for arms for America and the uninterrupted production of them depend on the "power heart" of this forging plant — the diesel engines.

Seven large diesel engines supply the power to speed this victory production. Three of them have been in operation for 16 years on a 24 hour basis and lubricated with Sun Diesel Oils. Today these same engines are operating with original cylinders, the walls of which have never been rebored and there has never been a breakdown due to faulty lubrication. That's a typical record set with Sun Solnus Oils — the modern diesel lubricants developed to give long hours of uninterrupted operation.

Long liner life . . . no hard carbon . . . freedom from stuck rings . . . economical operation, that's what Sun Oil Engineers — those Doctors of Industry — are proving can be achieved. These skilled technical men are ready, willing and able to help you step-up the operating efficiency of your diesels and the products they have to offer have been developed to maintain that improved efficiency. For proof of what Sun Service can accomplish write for "Helping Industry Help America."

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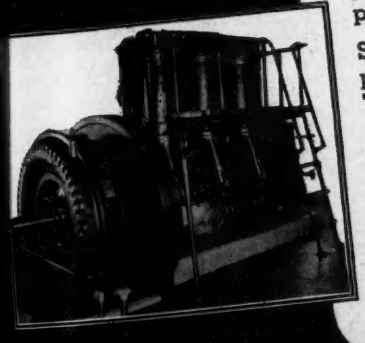


SUNOCO

SUN PETROLEUM PRODUCTS.. HELPING INDUSTRY HELP AMERICA

AN AMERICAN ENGINEER LOOKS AT EUROPE

(Continued from Page 77)

grown to an important annual figure and the idea should be further expanded in the future. From many points of view this is a most advantageous form of export. The money obtained goes toward liquidating our development and research costs, thus tending to reduce our domestic costs; the responsibility for the quality of materials, for the building and assembly of the equipment and putting it into service is assumed locally; and finally by helping the smaller and poorer countries improve their industrial facilities we help raise their standard of living, which in turn makes our own standard of living more secure.

This is a very short and superficial look at Europe, but two points have been brought out. First, we must greatly improve our labor relations if we are to survive as a democracy. The pendulum has swung over to state socialism and we need a magnetic brake in the form of sober public pressure to prevent it swinging too far in the opposite direction. The second point is that any plan for stable economy after the war must take into account our foreign commerce, which must be based on a liberal attitude toward other countries. There are millions of people outside the U.S.A. and the easier we make it for them to live decently, the less they are likely to want to fight every 25 yr.

THE CONSTRUCTION OF ALINEMENT CHARTS

(Continued from Page 84)

The number is equal to $(1.398 - 0.635)\ (1 \times \frac{1}{0.635}) + (1 + \frac{1}{0.635})$

$$= \frac{0.763}{0.635} \times \frac{0.635}{1.635} = 0.467$$

The equation becomes:

$(\log P - 4.67) - \log (0.755T + 347) + 1.575\ (0.635 \log V + 0.296)$

6. The (sum of the coefficients of the first and third terms) divided by (the negative of the coefficient of the second term) equals $\frac{1 + 1.575}{1} = 2.575$. Operating in accordance with rule 6, the equation becomes:

$$(\log P - 0.467) - 2.575 \left[\frac{1}{2.575} \log (0.755T + 347)\right] + 1.575\ (0.635 \log V\ 0.296) = 0$$

or $(\log P - 0.467) - 2.575\ [0.388 \log (.755T + 347)] + 1.575\ (0.635 \log V + 0.296)$

7. Values of y for the three variables are calculated and tabulated for each of the three variables in the accompanying table.

8. In accordance with rule 8, the first term scale (scale of P) will be located at $x = -1.575$; the second term scale (scale of T) will be located at $x = 0$; the third term scale (scale of V) will be located at $x = 1$.

9. Suitable scales are chosen independently for x and y in order to secure a chart of the desired size as shown in Fig. 2.

10. The tabulated values of y are used to locate the scale points of P, T, and V on the chart. The desired intermediate points are determined graphically.

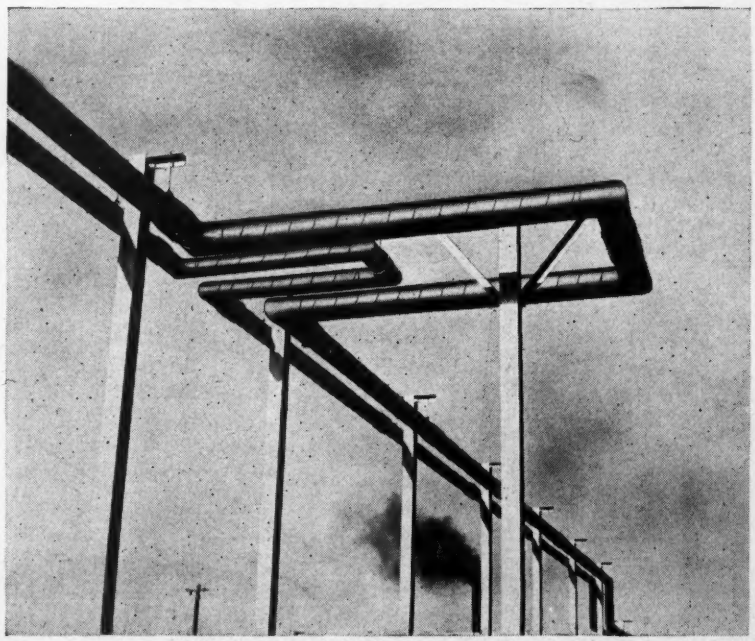
Using this completed chart, the value of any variable may be determined if the values of the other two variables are known by drawing a straight line through the two known points on their respective scales. The intersection of this straight line with the remaining scale will represent the value of the other variable. The dotted line of Fig. 2 indicates a typical example.

NOTE: This is the first of two articles on the subject by Mr. Sealey. A second will appear in a subsequent issue.

SPEED OF CONSTRUCTION WAS VITAL

CONDITIONS sometimes make it desirable, if not necessary, to run steam and steam return lines overhead, as was the case illustrated, showing an overhead U-type expansion loop. Prefabricated insulated pipe units were brought by truck to the job, virtually ready to hoist into place. Several units were welded together on the ground, and these welded sections were then hoisted into position, eliminating the need of hoisting numerous single units and attempting the welding overhead.

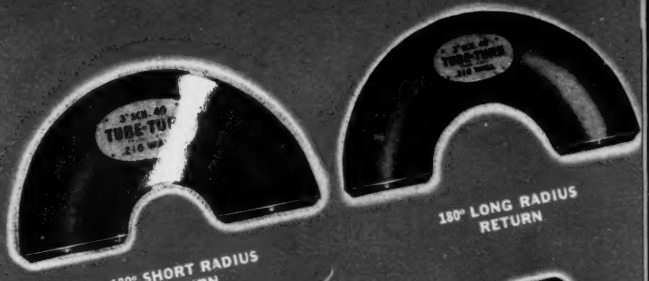
In two days, 1500 ft. of the insulated pipe units, manufactured by the Ric-wiL Co., were installed in place on channel steel upright supports, ready for connector bands and insulation between units. The units are made from heavy gage Armco pure ingot iron.

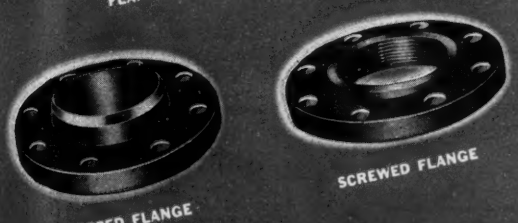


These insulated pipe units were welded together on the ground and hoisted into position, thus eliminating overhead welding

Types, Sizes and Weights for Every Pipe Welding Need

TUBE-TURN
WELDING FITTINGS





TUBE-TURN WELDING FITTINGS—RANGE OF SIZES

TYPE OF FITTING	DESCRIPTION	STANDARD WEIGHT	EXTRA STRONG	SCHEDULE 160	DOUBLE EXTRA STRONG
ELBOWS	90° LONG RADIUS	½"-24"	¾"-24"	1"-12"	1"-8"
ELBOWS	90° SHORT RADIUS	1"-24"	1½"-24"		
ELBOWS	45° LONG RADIUS	½"-24"	¾"-24"	1"-12"	1"-8"
RETURNS	180° LONG RADIUS	½"-24"	1"-24"	1"-12"	3"-8"
RETURNS	180° SHORT RADIUS	1"-24"	1½"-24"		
RETURNS	180° EXTRA LONG RADIUS	1"-2½"	1"-2½"		
TEES	STRAIGHT	¾"-24"	¾"-24"	1"-12"	1"-8"
TEES	REDUCING OUTLET	¾"-24"	¾"-24"	1"-12"	1"-8"
REDUCERS	Concentric and Eccentric	1x¾"-24x20"	1x⅜"-24x20"		1x¾"-12x10*
CAPS		1"-24"	1"-24"		1"-24"
STUB ENDS	LAP JOINT	1"-24"	1"-24"		
NIPPLES	Shaped, 90° or 45° to Header	1¼"-12"	1¼"-12"		
SADDLES		2"-24"			
LATERALS		1¼"-24"	1¼"-24"		
CROSSES		1¼"-24"	1¼"-24"		
RINGS		¾"-12"	1¼"-12"		
		150, 300, 400†, 600 and 900* Lb.		1500 Lb.	2500 Lb.
FLANGES	WELDING NECK	½"-24"		½"-24"	½"-12"
FLANGES	SLIP-ON	½"-24"		½"-12"	½"-12"
FLANGES	LAP JOINT	½"-24"		½"-24"	½"-12"
FLANGES	THREADED	½"-24"		½"-12"	½"-12"
FLANGES	BLIND	½"-24"		½"-24"	½"-12"

† Dimensions on sizes thru 3½" same as for 600 lb. flanges.

* Dimension on sizes thru 2½" same as for 1500 lb. flanges.

For sizes of light gauge and super-weight fittings, forged steel flanges, and for complete specifications on all Tube-Turn fittings, refer to *Tube-Turn Catalog.*

TUBE-TURN TRADE MARK *Welding Fittings*

The FIRST WELDING FITTINGS 1ST AND STILL THE BEST

TUBE TURNS, INC., LOUISVILLE, KY. *Branch offices:* New York, Chicago, Philadelphia, Pittsburgh, Cleveland, Tulsa, Houston, Los Angeles, Washington, D. C. *Distributors in all principal cities.*

West Virginia Coal Meeting Covers Vital Fuel Needs

Against a background of war, with production and transportation in the foreground, the University joins with the new Coal Bureau of the U. M. V. A. to promote more efficient use of fuel resources through better selection and application of fuel, improved combustion and equipment maintenance. Over 230 met at Morgantown, July 24

AS AN EXPERIMENT in regional planning under private enterprise and voluntary cooperation the Upper Monongahela Valley Association, with headquarters at Fairmont, W. Va., is of much more than local significance. Many feel that, under either government or private direction, regional, as contrasted to political and geographical, development is bound to play an increasingly important role in the Nation's economy.

Recently the Coal Bureau of the Association was formed with the active support and cooperation of coal producers representing some 85 per cent of the production capacity of the district. Acting jointly with the University of West Virginia, the Bureau made its first bow to the public July 24 at an Industrial Fuel Engineering Conference, opened in the University's new $1,000,000 Mineral Industries Building, on the Morgantown campus.

While the meeting was aimed at fostering the local objectives of the Association, the program was sufficiently broad to bring together over 230 coal producers, coal consumers, equipment manufacturers, fuel and research engineers from 12 states, the Province of Ontario and the District of Columbia.

The war, war production and transportation limitations have caused very definite industrial fuel problems. The Conference was directed toward the solution of these vital fuel problems by: better cooperation between groups involved; effective utilization of mine, transportation and handling facilities; and elimination of waste at the plant by proper fuel application, efficient combustion and good boiler design and maintenance.

A. C. Spur, president of the Monongahela West Penn Public Service Co., secretary of the Association and chairman of the Coal Bureau Management Committee, opened the meeting. He, together with J. E. Tobey, director of the Coal Bureau and chairman of the meeting, and Dr. C. E. Lawall, president of the University, outlined the aims of the meeting and the purpose of the Association: to advance the agricultural, recreational, commercial and industrial development of the Valley.

Coal is the principal natural resource of the district and coal mining has for generations been one of the key industries. H. N. Eavenson of Eavenson, Alford & Auchmuty, consulting engineers of Pittsburgh, and Dr. P. H. Price, state geologist, covered the history, economics and geology of the district in considerable detail.

Some coal was shipped from the state by water through Wheeling in the 1820's, but not until the railroad was built to Newburg in 1851, and later extended to Fairmont and Clarksburg, did mining from the Pittsburgh seam in the West Virginia area become really effective. For the last decade it has remained stationary at over 5 per cent of the national total. The so called Pittsburgh coal bed covers some 15,000 sq. mi. in four states with about 39 per cent of the coal, lying in seams of 3 ft. and over, in West Virginia. In general the Fairmont district coal is high volatile running from 11,300 to 11,700 B.t.u. as received and with a relatively high iron and sulphur content.

It was upon this latter point that E. G. Bailey, vice president of Babcock & Wilcox Co., placed particular emphasis in discussing the Future of Northern West Virginia Coals, which he said, were "not overproduced but undersold." High iron and high sulphur go hand in hand. Due to allowances which must be made in boiler design to reduce moisture and corrosion, there is a reduction of from ½ to 1 per cent efficiency for each 1 per cent sulphur in the coal. Below 5 per cent iron need cause no concern, above this it becomes important and around 10 per cent must receive serious consideration because of its influence on the boiler slagging problem.

Slagging troubles depend primarily upon gas temperatures and ash softening temperatures, which in a given boiler, are mutually related because as ash and slag collect on the surfaces radiant heat transfer is reduced and the furnace temperatures increase to aggravate the trouble. Mr. Bailey presented data to show that ash fusing temperatures bear a definite relationship to iron content. He also drew attention to the fact that fusing temperatures as determined in the laboratory with an oxidizing atmosphere are from 200 to 400 deg. F. higher than in an oxidizing temperature as approximated in an actual boiler.

Samples taken from boiler units show a higher iron content in slag than in the coal. Dry ash samples on the other hand show the same or a lower iron content than the coal. Dry ash samples taken from tubes show that for iron content above 12 per cent, the melting temperatures stabilize at about 2400 deg. F. so that, with gas temperatures keep below this figure "bird nesting" should cause no trouble.

Whether slag tap or dry bottom furnaces will eventually come out on top remains to be seen. Both are operating successfully under different conditions. The range where the two overlap is, however, a trouble area and Mr. Bailey advised "be either hot or cold, don't be lukewarm." A boiler and furnace to handle low fusing ash coal is more expensive and in one installation, referred to specifically, the cost differential was such that the low fusing ash coal had, to break even, a favorable cost differential of 7 ct. per t.

Ollison Craig, engineering manager of the Riley Stoker Corp., said that for a number of years he has advocated designing plants to burn both coal and oil. Along the Atlantic seaboard especially this has proven advantageous because current costs sometimes favor oil and sometimes coal. During the present oil shortage there two-fuel plants are of course in a very advantageous position. Mr. Craig also presented many case studies showing how comparatively small changes, in furnaces, waterwalls, baffles, ducts, etc., made substantial improvements in efficiency and capacity. In one case the addition of a water-cooled Dutch oven to a Wickes vertical boiler increased the rating from 125 to 250 per cent.

Many of the points mentioned by Mr. Craig were demonstrated in a case study by Theodore Maynz, supervisor of power of the American Viscose Co. He reviewed in considerable detail changes made since 1926 in the company's Parkersburg plant to obtain greater capacity and a wider latitude in the selection of fuel. Original boilers were stoker fired. Later pulverized coal was added in an endeavor to get higher capacity and better performance. This was successful but in the latest endeavor to get maximum capacity, Westinghouse water cooled underfeed stokers are being used. Two units are involved and, while the war caused some delays, the first was expected to be in service early in August.

All industries and utilities are being urged to store at least 60 da. coal supply, said I. J. Thomas, assistant director, Coordinator of Solid Fuels, and on June 30 some 67 million t. were in storage, the largest dead storage since 1923. Transportation is, of course, the critical item for, so far this year, the railroads handled freight at a rate approximately double the peak year of 1929.

Increased efficiency and the Diesel engine have materially cut into the potential market for coal in both railroads and utilities. Approximately half the locomotives now on order are Diesel driven. Furthermore, coal consumption has dropped from 171 lb. per thousand gross tons of freight in 1920 to 112 in 1941. On the basis of 1941 loads and 1920 efficiency this means a coal market drop of 60 million tons. In the utility field 1941 loads at 1920 efficiency would mean an increased coal consumption of 95 million t. These two items total roughly a third of the annual bituminous coal production. The coal industry must develop new markets if coal production is to be maintained after the war.

(Continued on Page 122)

HOW TO CONSERVE COPPER

IN CABLE SYSTEMS FOR WAR-JOB PLANTS

Use HIGHER VOLTAGE

WHEN you are planning expansion of an electric distribution system, or revamping plant wiring, there is an opportunity to save copper (compared with previous practice) by using as high voltage as you can. For example, cable at 480 volts requires only 26 per cent of the copper required for distribution at 208 volts.

Other effective conservation measures, when planning plant distribution for war production, are (1) use a high-temperature insulation because temperature limits of the insulation govern the permissible copper size; (2) use three-conductor instead of single-conductor cable wherever voltage regulation is the deciding factor, because the reactance drop in a three-conductor cable is less.

HOW MUCH COPPER CAN YOU SAVE?—Ask Us

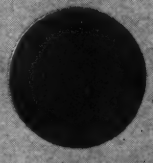
In practically every case there can be a choice between two or more cables to do a job well. One, however, may permit a saving in copper—and will also conserve other vital materials.

Let us help you determine the cables that will do the job successfully and that will also conserve copper. General Electric cable engineers, both in your section of the country and at the factory, offer their services in figuring for you, or with you, just what the opportunities are.

When you save copper in the cable, you conserve copper in that part of the plant electrical distribution system where the copper requirements are the heaviest. For additional information, just ask the nearest G-E office, or write to General Electric, Schenectady, N. Y.

The Navy "E", for Excellence, has been awarded to 92,780 General Electric employees in five plants manufacturing naval equipment.

NOT THIS



500,000 cir mils—conductor size for *208 volts*

4.6 LB COPPER PER FOOT

BUT THIS

2/0 Awg—conductor size for *480 volts*

ONLY 1.2 LB PER FOOT

GENERAL ELECTRIC

501-15-1200

War News From the Industrial Front

REA Brought to Full Stop

GROWING needs of the armed forces for copper and steel was given as the reason for the drastic action of the WPB, Aug. 13, in halting the REA construction program. The action came as an amendment to the March order granting the REA permission to complete projects 40 per cent completed on Dec. 5, 1941. Twenty projects have been completed leaving 15 to be stopped, unless completion is specifically authorized by WPB.

Construction of private utility plants not directly concerned with war production had been brought to a virtual standstill earlier. Out of some 9,300,000 kw. projected, approximately 5,300,000 kw. were earmarked for completion and the remaining 4,000,000 held in abeyance ready to be carried through without delay should changing conditions make that advisable. Government hydro projects involved are in general being carried on to the point where critical materials are needed.

On August 21 WPB announced that work had been halted on 85 public and private power projects. This was in accordance with the announced policy of stopping construction on most new war plants which cannot be completed by the end of 1943. The 85 projects represent a total of 2,200,000 kw. scheduled for 1943 and 1944. Of this about 350,000 are on the suspended list subject to reinstatement. The list of projects affected, and government projects with low priorities on material appears on p. 164.

Don't Use Hopper Cars

WITH A view to easing the growing tightness in the supply of hopper-type freight cars, used for hauling coal, ODT Director Eastman urged shippers to order gondola cars or other types of equipment for the shipment of various bulk materials not requiring the use of hopper cars. In sections of the country where a surplus of box cars exists, even these might be used, provided such equipment could accommodate the shipment, Mr. Eastman said. Later Mr. Eastman pointed out that the supply of gondola and flat cars was also critical and urged that orders for open top cars be placed so that box cars could be substituted if convenient and practical.

WPB Tightens Up on Electric Motors

FROM now on new electric motors will be available only for the most important war and civilian requirements, according to an announcement by WPB. Other applicants must get along with used equipment of which there is said to be an ample supply.

Government agencies are now making a check of used motors available for industrial purposes. Motors are being added to the list at the rate of a thousand a day, classified according to type, horsepower, voltage, etc. Eventually, this record is expected to reach a total of 300,000 motors.

WPB has asked owners of motors adapted to commercial purposes to communicate with the Conservation Division, Used Equipment Section of WPB, giving all relevant information. This section will then index the motors to simplify finding the correct kind of equipment for a specific job.

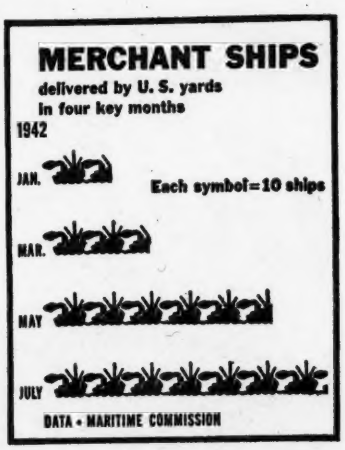
Army, Navy Can Order Extension of Facilities

PREFERENCE Rating Order P-46, as amended, was further amended July 23, in Supplementary Preference Rating Order P-46-a, to permit utility companies to make extensions to gas, water, or electric lines for the Army, Navy, or Maritime Commission upon direct order by them. Length and cost limits are imposed.

Electric Meter Output to be Curtailed

PRODUCTION of the common household electric meter will be curtailed for the duration under an order issued July 31 by the WPB. At the same time, restrictions on deliveries to take effect immediately were ordered.

This action is expected to make available about 750,000 lb. of copper for military purposes at current rates of production. In addition, approximately 3,000,000 jewels of an industrial type will be made available for precision instruments used in military operations. It was pointed out that available stocks of meters are ample to meet all essential requirements.



Not enough ships in spite of the July record of 71 vessels totaling 790,300 t. The rate of production is now up to the President's goal of 8,000,000 t. by the end of the year and the production for the year will probably exceed that in spite of the smaller output during the first 6 mo. The 1942 total through July is 299 ships of 3,338,515 t. W.S.A. revealed that new shipping was unequal to United Nations losses and the Dec. 7, 1941 total of available tonnage will probably not be exceeded until well into 1943

VITAL NEED FOR NEW AND USED TURBO-BLOWERS

The Turbo-Blowers Unit, General Industrial Equipment Branch, WPB, Washington, say: "We are very anxious to reach the used equipment industry with information on the vital needs for used and reconditioned turbo-blowers, for the steel, synthetic rubber, chemical and petroleum industries. Certain new and used turbo-blowers have been put on the critical list by the War Production Board, as covered by General Limitations Order No. 163 . . . We are appealing to you for help in reaching this industry with this vital information . . ."

Under Limitation Order L 163, WPB takes strict control over turbo blowers, made largely of alloy steels and cast iron. No one may place or accept orders for turbo blowers unless specific authorization is granted on Form PD-616A. Application for authorization to place orders must be made on Form PD-616.

Manufacturers and dealers with whom authorized orders are placed must accept such orders, unless the person seeking to place the order is unwilling or unable to meet regularly established prices and terms of sale or payment. Regardless of any prior commitment or preference rating, manufacturers and dealers were prohibited, beginning August 22, from delivering any turbo-blowers unless authorized.

Manufacturers and dealers were required to file a statement showing the orders for turbo-blowers they had on hand as of August 7, a description of the equipment, names of the proposed purchasers, and the preference rating certificate number and the rating assigned to each order.

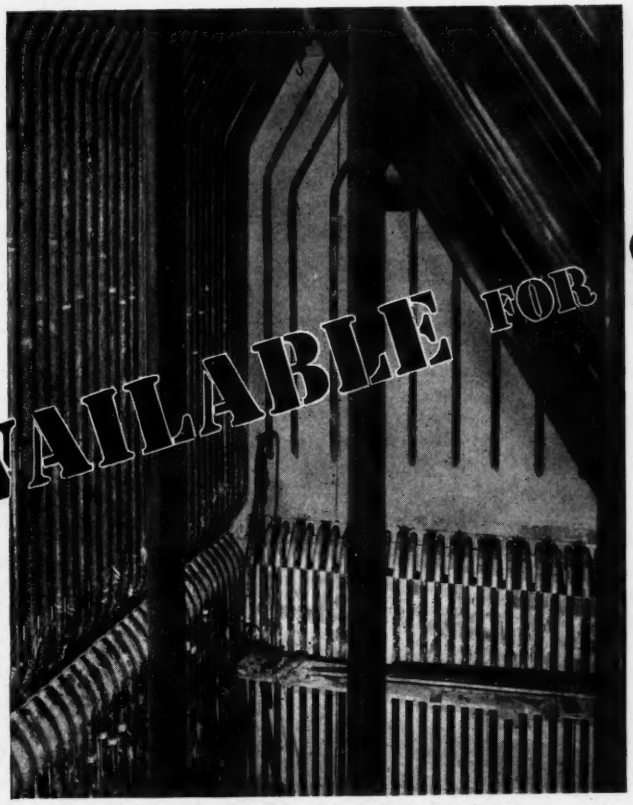
Turbo blowers listed in these statements for delivery on or before August 31 may be delivered without specific authorization upon receipt of the statements by WPB. However, the Director General may revoke such automatic authorization or change delivery schedules at any time.

In order to obtain clearance of deliveries of turbo-blowers not scheduled for delivery before August 31, manufacturers or dealers must file applications on Form PD-616B on or before the 25th day of each month. Unless the Director General orders otherwise, delivery schedules set forth in these monthly reports may be carried out without specific authorization.

The order, although in the L series, does not limit production directly but provides for allocation of finished products

Critical turbo-blower means any new, reconditioned or used centrifugal or rotary type blower or exhauster having a capacity of 10,000 cu. ft. per minute or more, at a total pressure of 2 pounds or more; except any such equipment to be delivered to the United States Navy or Maritime Commission for shipboard use, or to any privately owned shipyard or plant for installation in ships built, or repaired, for the United States Navy or Maritime Commission.

All reports required to be filed and all communications concerning this order should be addressed to: War Production Board, General Industrial Equipment Branch, Washington, D. C. Ref.: L-163.



AVAILABLE FOR SERVICE

Interior view of steam generator at Parr Station

10,615 HOURS OUT OF 10,848

A RECENT Foster Wheeler steaming unit had only *two* outages (233 hours) in 15 months of regular service. That means an availability of 97.8% which although high, is an incomplete picture of the boiler performance. The largest outage was due to a flooded coal bunker caused by a broken drain. The only outage chargeable to the unit itself was less than one per cent, resulting from a loose exhauster liner.

This installation is at the Parr Station of the South Carolina Electric and Gas Company, capacity 162,000 pounds per hour at 450 lb. per sq. in. pressure and 750 deg. F. final steam temperature.

FOSTER WHEELER CORPORATION

165 BROADWAY, NEW YORK, N. Y.

The all Navy "E" for Excellence in Production, has been awarded to Foster Wheeler in recognition of quality equipment, in quantity, on time.

FOSTER WHEELER

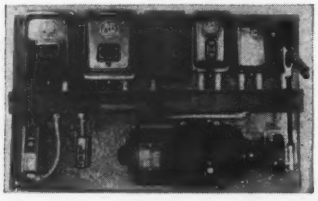
New Equipment

Information that you desire about any equipment will be gladly furnished without obligation. WRITE POWER PLANT ENGINEERING.

Automatic Damper Regulator

THE American Damper Regulator of the American Coal Burner Co., 18 E. Erie St., Chicago, Ill., is adaptable to Fyr-Feeder installations which are operated by 'on and off' method of control. Consisting of a geared motor which moves damper control arm up and down. Limit switches stop motor at proper points at top and bottom of stroke.

In operation, when the pressure switch on the control panel closes due to a drop in steam pressure below the predetermined point, the damper motor regulator starts, opening the stack damper. Ten seconds later, after damper is fully opened, switches on control panel start coal feed, coal blower and forced draft motors.



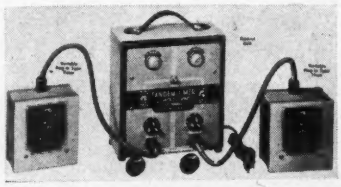
When steam pressure reaches desired point, pressure switch opens, stopping coal feed, coal blower and forced draft fan motors and starting damper regulator motor. This runs for 10 sec., closing stack damper and conserving furnace heat and fuel.

Being no possibility of stoker or forced draft fan starting before damper is wide open, there is no possibility of flare back through the fire doors.

Tandem Timing Device

THE TANDEM TIMER, a new timing device announced by the Industrial Timer Corp., Newark, N. J., presents exceptional features which will be of particular value in production departments, laboratories, and for life testing of electrical apparatus, permitting practically any timing sequence that may be desired. The timer is essentially a control unit with two individual and variable plug-in type timing elements, which when adjusted to their correct respective time intervals, each cycle of operation will follow the other continuously in regular sequence. When the timer dials are once set at the time interval desired, further adjustments are unnecessary until a new sequence is required. The automatic reset features of the timer makes a continuous, as well as a single, cycle of operation possible.

The control cabinet measures 8½ by 8½ by 5 in. and contains the 'on and off' toggle switch, repeat and single cycle toggle switch, single cycle start push-button switch, pilot lamps, receptacles, and sockets into which are plugged the two timing elements which control the single pole double throw load relays. The contact circuits of the load relays are unpowered so that they may be powered with the particular voltage and current necessary for test or production requirement. The load relay contacts are rated at 110 v., 10 amp. a.c.



The timing elements are synchronous motor driven, automatic resetting timers, of sturdy design and construction, contained in a formed steel 6 by 5 by 3 in. box. A graduated dial and pointer knob allows quick and accurate selection of timing period.

Hand-Operated Stokers

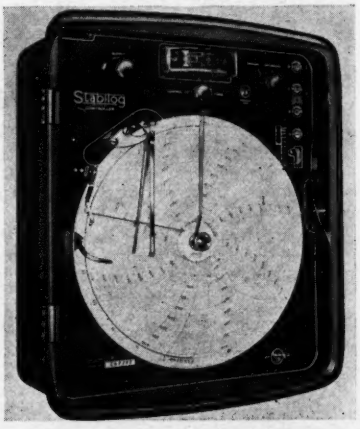
AMERICAN COAL BURNER CO., Chicago, Ill., announces the introduction of a complete line of its Self-Cleaning type hand-operated stokers for changing over boiler installations formerly dependent on fuel oil, or on fuels threatened with scarcity at the present time. The stoker employs the original "Cokal" firing principle, a coking method known for its ability to produce smokeless and efficient combustion with inexpensive sizes and grades of bituminous coal.

The virtual extinction of firemen skillful enough to get satisfactory results with ordinary grates is said to be one of the important factors leading to the introduction of this stoker. In the stoker, the coal is placed on the front of the stoker and is then distributed mechanically. One lever does it all, advancing the fuel towards the dump plate, where the ashes can be dropped as they accumulate.

The stokers are designed for operation with natural draft and require no steam or electric power. Sizes range from 100 lb. to 4000 lb. of coal per hour.

New Stabilizing Control

A NEW DEVELOPMENT in the field of control engineering has been announced by The Foxboro Co., Foxboro, Mass., under the name of Hyper-Reset. This is not an instrument or a mechanism but a control function for application where process-lag is considerable and is available in the newly-designed Model 30 Stabilog Controller. Its importance is demonstrated by tests in which Hyper-Reset consistently re-established process stabilization, following an upset, in one-quarter of the time, and with only one-half the upset effect, as compared with a similar controller having only the usual reset.



Hyper-Reset is designed to reduce the effects of a process disturbance by making initial temporary additional corrections, which are proportional to the rates of change of the measured value caused by the disturbance. The normal reset follows, establishing stabilization. Several control functions carried out by Hyper-Reset are simultaneously and automatically adjusted. No tuning-in is necessary. No more than two process adjustments are required, proportional and Hyper-Reset.

A.C. All-Position Welding Electrode

A NEW electrode designed specifically for all-position welding of mild steel with a.c. type welding machines has been developed by Wilson Welder and Metals Co., Inc. Made to fill a rapidly growing need for a high quality a.c. electrode for all-position use, the electrode is made in the following diameters: 1/16, 3/32, 1/8 and 5/32 in. An outstanding characteristic of this a.c. electrode is that average operators have no difficulty in securing good fusion and complete penetration. The finished weld deposit is said to have a smooth uniform surface contour.

THE Gilmer NATIONAL POWER-RECOVERY PLAN

USE WHAT YOU LOSE

IT SPOTLIGHTS POWER WASTE

ELECTRICITY
STEAM
MECHANICAL TRANSMISSION
COMPRESSED AIR
WATER
REFRIGERATION
BOILER ROOM
PRIME MOVERS

Gilmer BELTS

INSTRUCTIONS FOR USE OF ESTIMATOR

1. The Gilmer National Power-Recovery Plan contains a series of Estimators, each relating to a certain phase of power service such as electricity, steam, hot and cold water, mechanical transmission, compressed air, refrigeration, generation, etc. This Estimator covers that phase of power service assigned to you for checking for power leaks.

2. Spot and check all the leaks in the service. You probably know them well and welcome this opportunity to get the corrections made in order to improve production. The specific practical suggestions below may be helpful.

3. List the location of all principal power losses on the Estimator together with your recommendation for betterment. Group the losses as "Urgent", "Important", or "Less Important".

4. State the approximate time required to correct the power losses, and whether the needed materials for making the corrections are available. If they are not available, state what must be done to obtain them. Give an indication of the cost of the job.

5. Having filled out the Estimator, sign it, and return immediately to the person in your company from whom you received it.

Bear in mind that the objective of the Gilmer National Power-Recovery Plan is to save power. Do your part to make America powerful by reporting on this Estimator every principal power leak which it is feasible to correct in your department.

TYPICAL WAYS TO SAVE ELECTRICITY IN THE PLANT

Individual experience will suggest many other points of which power leaks can be plugged and power saved.

Fit the motor to the job—Inventory your motors in all departments. Make sure (a) that most efficient motors drive machines that run longest hours; (b) that each motor is big enough for the job, but no bigger (over-size motors lower power factor); (c) that low-speed alternating-current, direct-drive motors are not used where high-speed AC units with speed reducers would improve efficiency and power factor; (d) that several loads are grouped on one motor where this will reduce power consumption and increase production. Result: Saving of 15 percent in kwhr consumption and 20 percent in kva load.

★

Meter electricity to hold down waste-ful use—Install individual meters on machines where friction load is likely to "creep up", and on large motors driving machines where operator control amount of power used. Meter electricity to each factory department and charge department head for his actual consumption; nothing discourages waste like a monthly bill! Result: 5 to 20 percent saving in total kwhr consumption.

★

Check feeders to cut losses—Examine entire electrical distribution system to equalize loads on feeders, if necessary by interconnecting load centers. Test insulation to find defects causing actual leaks that sometimes amount to 5 to 10 percent of electricity distributed. Spot and correct overloaded feeders, particularly in buried conduits where overheating can cause failure. Remember that heat is the limiting factor; shift cables from high-temperature areas; rig means of cooling where shifting is impossible. Result: 3 to 5 percent saving in kwhr consumption; 5 to 15 percent increase in feeder capacity; prevention of sudden failures in the distribution system.

★

Boost power factor—If power factor is below 85 percent look for motors that are too large for their loads, for drives where synchronous motors should replace induction units. If these changes fail to increase power factor sufficiently, install capacitors. Result: A boost in the power factor from 70 to 90 percent increases peak capacity 30 percent.

★

Schedule loads to cut peaks—If peak load is high in relation to average loads, examine necessity of every load that contributes to the peak. See if some production operations can be staggered and if non-essential loads (air-conditioning for example) can be cut off during peaks. Result: Capacity is increased 100 kw for every 100 kw shifted from peak.

★

Lighting—Inventory all lighting for unneeded high-wattage lamps. Replace filament lamps with fluorescents, if obtainable, to get same illumination with 75 percent less kwhr consumption. Make one man responsible in each department for turning off unneeded lights. Result: 50 percent saving in lighting kilowatt-hours and peak kilowatts.

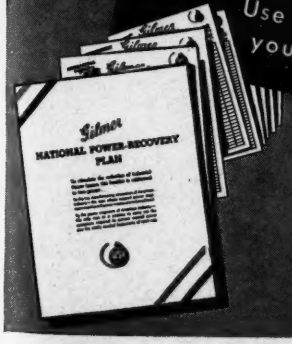
★

Maintain electrical system to cut losses and prevent failures—Organize for systematic cleaning, inspection, and repair of feeders, switchgear, transformers and motors. Establish a definite schedule and responsibility for these jobs, and see that the work is carried out. Result: Savings of 10 to 15 percent by the proper care and lubrication of motors and mechanical power transmission equipment; breakdowns are prevented which causes vital production outages.

★

The savings shown above are based on the experience of leading power engineers in hundreds of average plants throughout the country.

The Gilmer National Power-Recovery Plan is all contained in one convenient booklet. Use this coupon to get your copy.



L. H. GILMER COMPANY, Tacony, Phila., Pa.

Gentlemen:

Please send me a copy of the National Power-Recovery Plan, without cost or obligation.

Name_____

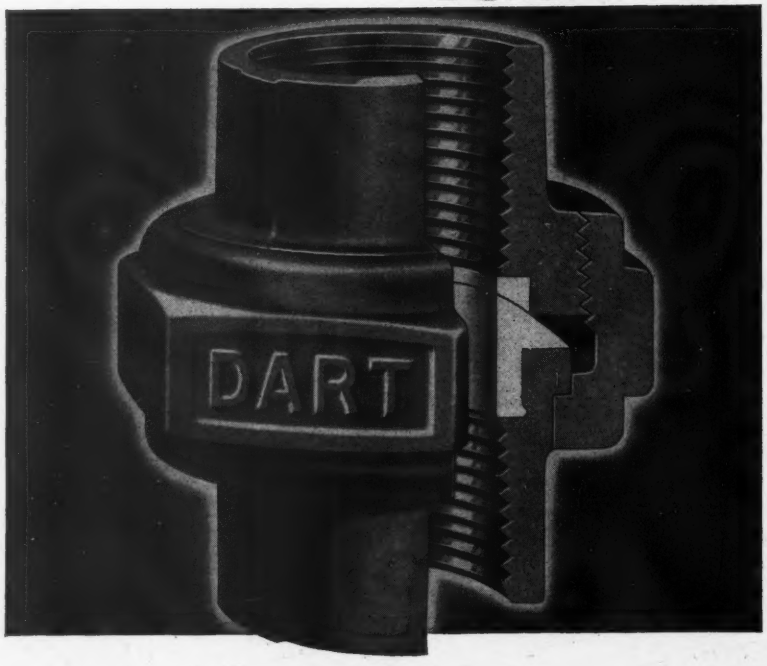
Firm_____

Address_____

You're Sittin' Pretty If You Have Any Old

DART UNIONS

You Can Put Back to Work



Lucky is the man who has some old Dart Unions kicking around his plant. For you'll find that those old discards can be put back on the job with excellent results. And this is right in line with Uncle Sam's program. The more metal you save, the more he can use for his guns, tanks, ships, and planes.

The reason you can re-use Dart Unions again and again and still get a stay-tight fit is an old story. Dart Unions are long-service Unions. Their bronze, matched seats are ground to "true-ball" surfaces—and their air-refined, malleable iron nuts and bodies stand up under rough handling.

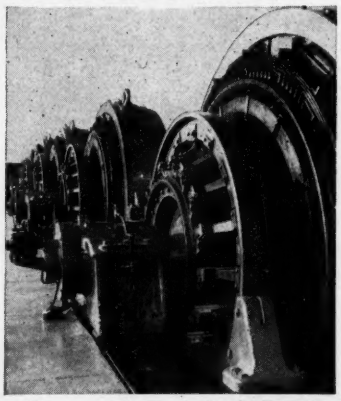
So get out your old Dart Unions and let them work side by side with the new ones you buy from your supplier.

DART UNIONS

E. M. DART MFG. CO., PROVIDENCE, R. I.

Flame-Resistant Insulating Varnish

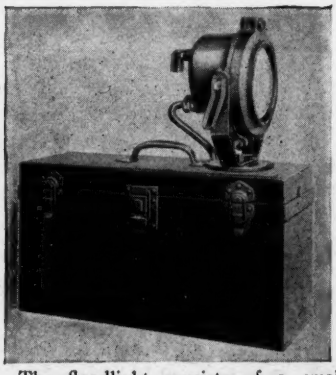
THE STERLING VARNISH Co., 166 Ohio River Blvd., Haysville, Pa., has recently developed a new flame-resistant insulating varnish, designated as R-878, which is recommended for class B high temperature insulation.



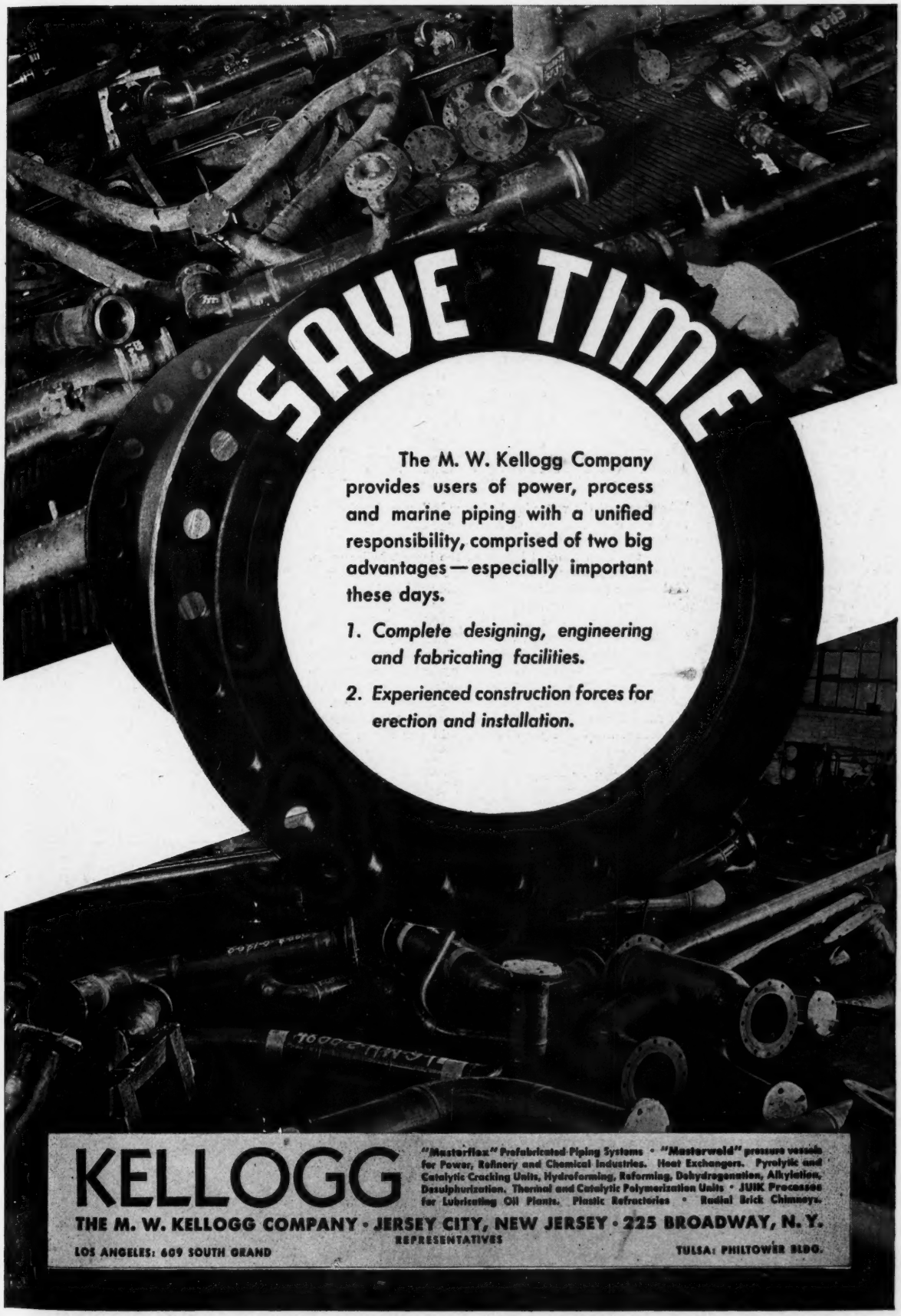
This varnish is mechanically strong and said to dry all the way through when applied to electrical apparatus, and after drying will not support combustion, when the flame is removed, nor melt or resoften under operating temperatures.

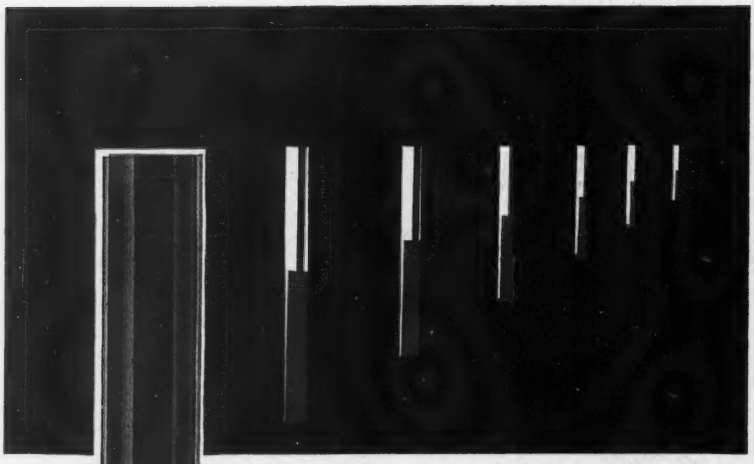
Portable Floodlight For Combustible Areas

A PORTABLE battery-operated floodlight has been announced by the Illuminating Laboratory of the General Electric Co., Schenectady, N. Y., especially for combustible areas which cannot have installed lighting. This unit is intended for use in such places as powder igloo interiors, powder magazines, freight car and warehouse interiors containing combustibles, and during blackouts and other emergencies.



The floodlight consists of a small steel box (19 by 9⅞ by 20¾ in.), with a special dust and vapor-proof lamp housing mounted on a bracket to allow pointing in any desired direction. A high-efficiency glass reflector, combined with pre-focus positioning of the unit's 50-candlepower concentrated-filament type bulb and a diffusive lens, gives a powerful medium-angle floodlighting distribution. A 5-cell storage battery with non-spill valves is housed in the box. Quick exchange of discharged for charged batteries is made possible through a polarized connector permanently wired to the battery terminals.


SAVE TIME
The M. W. Kellogg Company provides users of power, process and marine piping with a unified responsibility, comprised of two big advantages—especially important these days.
1. Complete designing, engineering and fabricating facilities.
2. Experienced construction forces for erection and installation.
KELLOGG
"Masterflex" Prefabricated Piping Systems • "Masterweld" pressure vessels for Power, Refinery and Chemical Industries. Heat Exchangers. Pyrolytic and Catalytic Cracking Units, Hydroforming, Reforming, Dehydrogenation, Alkylation, Desulphurization. Thermal and Catalytic Polymerization Units • JUIK Processes for Lubricating Oil Plants. Plastic Refractories • Radial Brick Chimneys.
THE M. W. KELLOGG COMPANY • JERSEY CITY, NEW JERSEY • 225 BROADWAY, N. Y.
REPRESENTATIVES
LOS ANGELES: 609 SOUTH GRAND
TULSA: PHILTOWER BLDG.



BOILER ROOM SENTRIES
that are always on the job

When you put the water level of your boilers under the protection of PYREX Broad Red Line Gauge Glasses, you choose sentries that never leave their posts.

Line them up the full length of the largest boiler room. The transparent broad red line fused directly to the wall of the gauge glass itself makes the liquid level visible in every glass from any distance.

PYREX Gauge Glasses are backed by brilliant service records, too. They are economical to use because they last longer. Machine drawn accuracy decreases installation strains. Resistance to thermal shock protects them against sudden temperature changes. Their remarkable chemical stability protects their transparency against the corrosive attacks of steam.

PYREX Gauge Glasses are a good investment in permanent protection. Stocked by all leading mill and steam supply dealers.

Left, a reproduction from an actual unretouched color photograph which illustrates the appearance of the gauge glass from directly in front.

"PYREX" is a registered trade-mark and indicates manufacture by Corning Glass Works, Corning, N. Y.

CORNING Glass Works Corning, New York

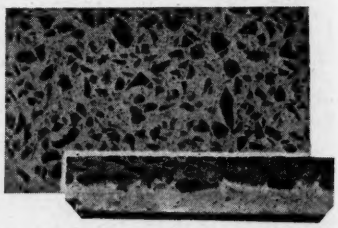
Pyrex Gauge Glasses

Change of Address

To avoid missing an issue or paying for forwarding postage be sure to send a change of address to our office. Changes received by the 20th of the month can be made effective for following month's issue.

Non-Slippery Flooring

DESIGNED to produce non-skid floors, either wet or dry, Walter Maguire Co., Inc., New York City, has announced the Cortland Emery Aggregate, a mixture of scientifically graded large and small, sharp, hard particles of mineral emery, rating next to diamond in hardness.



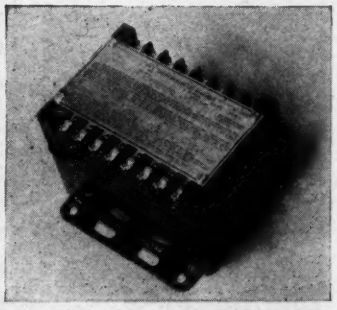
For application, the aggregate alone is mixed with Portland Cement and water for the floor topping. Even when an Emery Aggregate floor is wet, it is said to provide a firm non-slip gripping surface. The floor improves with wear and actually becomes safer with use, as the rough emery particles are exposed by wearing away of the cement, their gripping action improves. Where loads are moved by hand-trucking operations, much greater pushing traction is obtainable.

In addition, this flooring increases the load-bearing qualities. A Cortland Emery Aggregate floor mixture specimen is said to support a load of more than 14,000 lb.

Current Balancing Auto Transformers

TWO IMPROVED type A current balancing auto transformers for differential protection of power transformer banks are announced by the Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

The improved unit has been streamlined and clip terminal connections replace the cable leads. The pressed steel case eliminates heavy iron castings; and clip terminals eliminate sixteen rubber insulated cable leads.



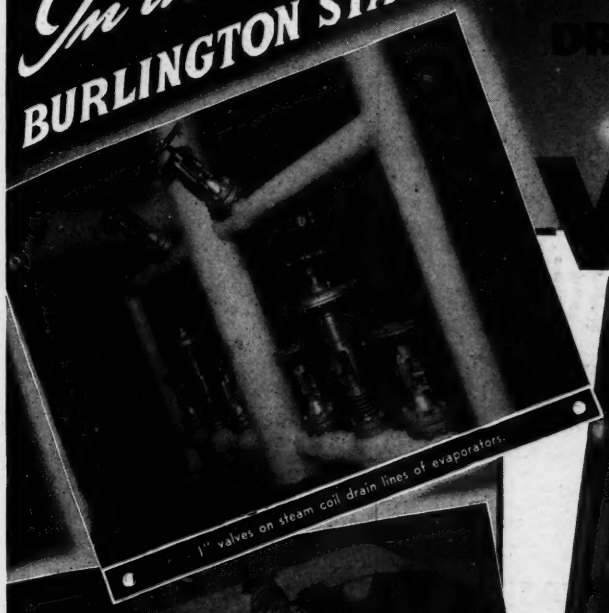
Clip terminals on the terminal block make it possible for connection to be made to the customer's leads without removal of any parts from the transformer. The diagram nameplate is mounted on top of the terminal block, and figures on the edges of the nameplate indicate the lead numbers. The mounting plate is arranged for flat surface mounting or pipe frame mounting by means of U-bolts.

Units are available in ratings of 50 and 100 v.-amp. with a nominal ampere ratio of 10.8/5 to 5/5.

(Continued on Page 134)

In the line at BURLINGTON STATION

DROP FORGED STEEL Steam VALVES



1" valves on steam coil drain lines of evaporators.

Here, 1" and 2" valves serve the lubricating oil purification system.

1" valves on drains of main steam line to low pressure turbines.

1" valves on auxiliary steam header drains.

Unit No. 5 at the Burlington Generating Station of the Public Service Electric and Gas Company has recently been placed in service. It consists of two 550,000 lb.-per-hour boilers which supply steam at 1,250 lb. and 950 deg. F., a 125,000-kw. condensing turbine-generator operating at 3,600 rpm., and the necessary auxiliary equipment.

Vogt *drop forged steel* socket weld end valves, as illustrated here, play an important part in the smooth, dependable functioning of this modern power plant.

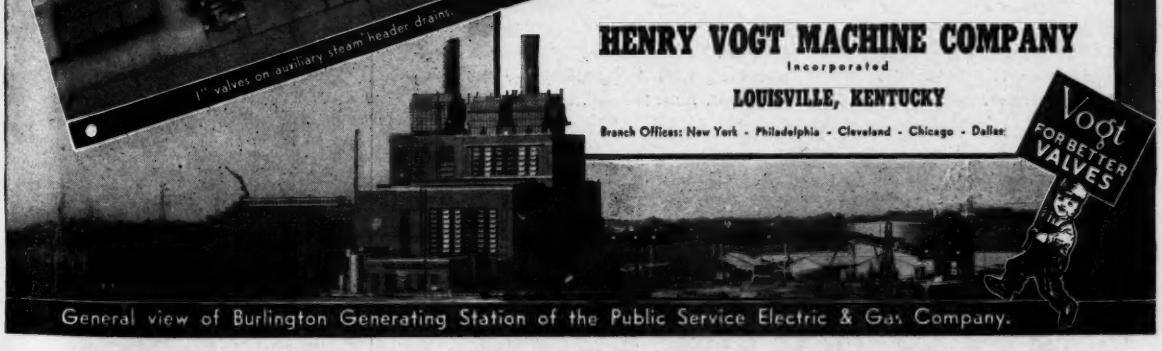
Catalog F-8 sent upon request.

HENRY VOGT MACHINE COMPANY

Incorporated

LOUISVILLE, KENTUCKY

Branch Offices: New York - Philadelphia - Cleveland - Chicago - Dallas



General view of Burlington Generating Station of the Public Service Electric & Gas Company.

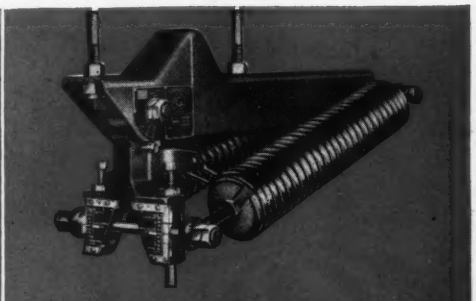
4

IMPORTANT TIPS

on Speedier Piping Installation!

No matter what type of piping system your plant-extension program may call for . . Grinnell's complete range of piping services and products offers short-cuts to a better installation! Here are four time-savers for *you* . . . four of many Grinnell products that are clipping months or minutes off today's war construction schedules involving piping.

1 **PREFABRICATED PIPING** by Grinnell saves fabricating and erecting time . . . . supplies speedily-erected, pre-tested sub-assemblies for complete power or process piping systems.



2 **GENSPRING CONSTANT-SUPPORT HANGERS** for high temperature piping are pre-fitted to exact engineered layouts . . . . . provide floating suspension, speedily installed, for loads from 250 to 8,500 lbs.

3 **GRINNELL WELDING FITTINGS** are identically metal-matched with your pipe or tubing . . . faster-made to cut minutes-per-weld in pipe erection.

4 **ADJUSTABLE PIPE HANGERS** by Grinnell are engineered to provide the right hanger for ANY piping ANYWHERE. Faster to install . . . more compact.

WRITE FOR Data Folders on these Grinnell time-savers. Grinnell Company, Inc., Executive Offices, Providence, Rhode Island. Branch offices in principal cities.

GRINNELL

WHENEVER **PIPING** IS INVOLVED

WEST VIRGINIA COAL MEETING

(Continued from Page 112)

One of the highlights of the meeting was an unusually effective presentation of current research, financed by various coal and equipment manufacturers, and being carried out at Battelle Memorial Institute. This was conducted by Ralph A. Sherman, supervisor of fuels of the Institute and a staff of Institute research engineers.

Much of the work lies in the industrial furnace and domestic fields; smokeless stoves; a new rotary stoker for households and small industrial users with the coal feed on the periphery and ash discharge in the center; the Battelle residential stoker with the coal fed by a vertical screw in the center and ash discharge at the periphery; and pulverized coal as applied to industrial furnaces.

Oil treatment for dustless coal has been thoroughly investigated, but the war brought new problems for oil is no longer available and other materials are being investigated. The effectiveness of the coating depends upon the porosity of the coal which varies widely. Calcium chloride in both dry and liquid form has been used with some success.

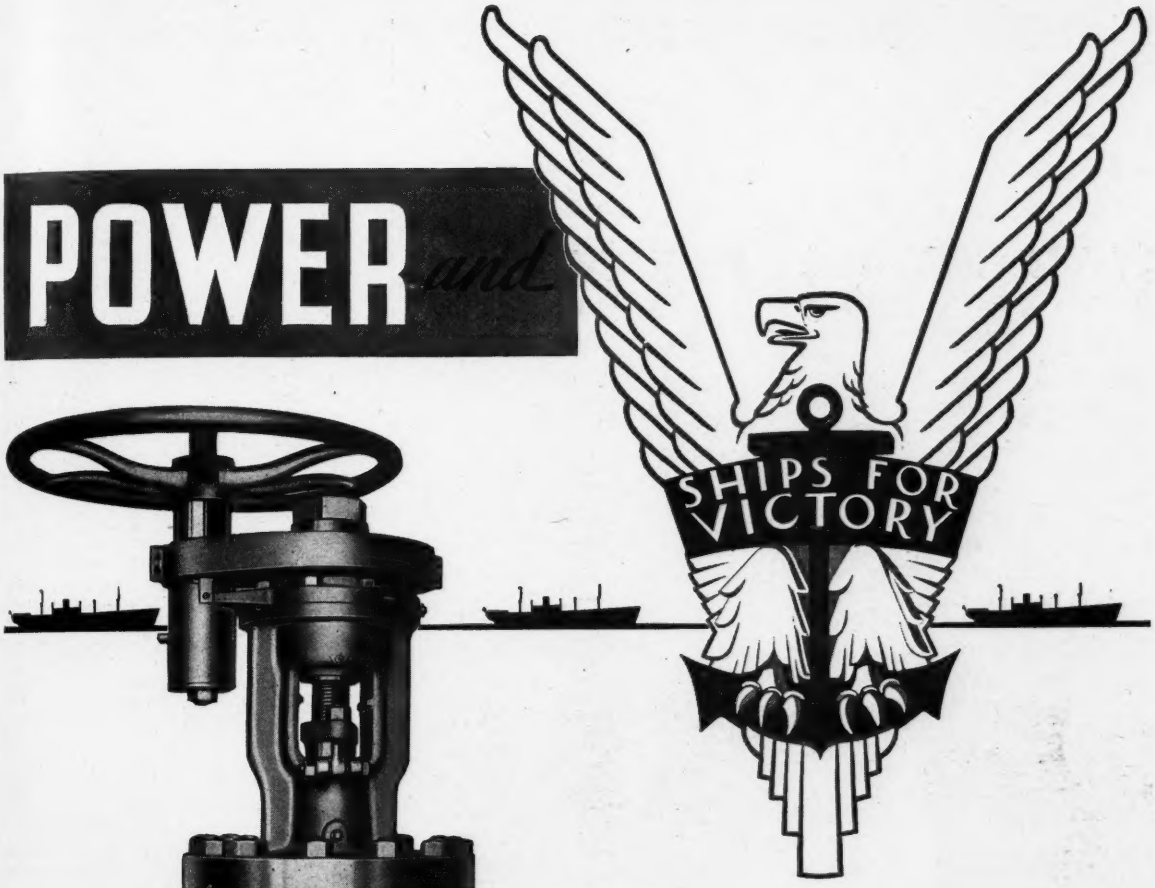
Perhaps the most interesting investigation is in connection with the application of pulverized coal to the Humphrey pump. The Humphrey pump is fundamentally an internal combustion engine, the piston of which is a surging column of water. Pumps of this type operating on gas have been in service in England since before the last war and the Sun Shipbuilding Co. has been interested in their development in this country for a number of years.

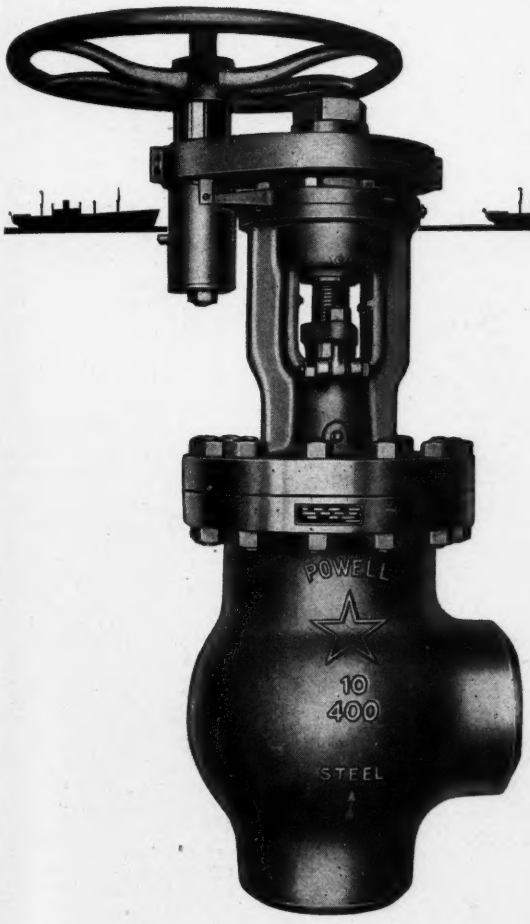
The present investigation was started as a possible relief measure for last year's water shortage in the T.V.A. area. Pumps of this kind, handling water from the tailrace to the forebay, could keep hydro units operating full capacity regardless of steam flow. Babcock & Wilcox collaborated in the design of the pulverizer and ignition system and the pump proposed for Wheeler Dam would have had a cylinder 19 ft. in diam., burned 2½ t. of coal per hr. and handled water equivalent to 4500 kw.

In connection with Wheeler Dam the pumps would have in effect provided steam standby capacity without requiring boilers or turbines, an important consideration at this time. Better water conditions in the T.V.A. area this year made it advisable to drop the plans at least temporarily but at the time of the meeting, a similar installation was being considered for Keokuk Dam on the Mississippi.[1]

[1]Since then, information from the officials of the Union Electric Co. of Missouri indicate that as far as Keokuk is concerned "the Humphrey pump idea is a dead issue." It is said an investigation by the company engineers failed to convince them of the merit of the idea as applied to their conditions. In their opinion "neither its cost of installation nor its equivalent operating cost offered any prospect of being less than an equivalent steam station" and the most optimistic appraisal did not encourage the experiment. It should be kept in mind, however, that during the war, cost may not always be a deciding factor and where power is necessary the Humphrey pump offers possibilities through its small use of critical materials with no drain on already overburdened boiler, turbine and electrical manufacturing facilities.

POWER *and*





This 10" Class 400 pound Cast Steel Angle Valve has welding ends, anti-friction bearing yoke with Alemite fittings, and spur gears, handwheel operated. An outstanding example of Powell designing and engineering, it definitely answers the demands of modern power plants for dependable, long-life, easily operated, flow control equipment.

"SHIPS, ships and more ships" is a by-word in war production today. Ships we must have in unprecedented numbers and on unheard-of schedules.

Power we must also have to drive the machines that fabricate the materials from which the ships are built and the many items with which they must be equipped. And we must have valves for the plants that make the power.

Many of these will be Powell Valves. So many, in fact, that the Powell factories are working 'round the clock seven days per week to supply the demand.

We are proud of our participation in the creation of America's War Machine. We are thankful that the years we have spent in building up our engineering and manufacturing facilities may now be turned over to the service of Our Country. We are glad to devote the full time of all of our facilities to the building of valves for the Ships and Power Plants of Victory.

The Wm. Powell Company

Cincinnati, Ohio

POWELL VALVES

INCINERATOR ARCH AND FLOOR *quickly installed* WITH CASTABLE REFRACTORY!

Another example of jointless refractory construction for tough service—with a LUMNITE Castable Refractory

IT'S QUICK AND EASY. Today that is an important advantage of a Castable Refractory installation. In jobs like the arch and floor shown above, the cast-in-place refractory, made with LUMNITE, is ready for service 24 hours after placing. Large jointless sections are as easy to cast as small precast units.

You buy the dry prepared mixture of refractory aggregates and LUMNITE to start with. You add water to the mixture, right on the job... pour it in a simple form. It quickly gains high cold-strength and is ready for service in 24 hours.

For walls, arches, floors, you get a jointless, one-piece refractory that prevents loss of heat and infiltration of air, and does not suffer from moisture or steam. There is no cutting or fitting to do ... no ramming (you just tamp it in). No shrinkage to bother about. Spalling resistance is high. Upkeep costs are low.

When you use a Castable Refractory made with LUMNITE, you are sure of a balanced refractory, the result of careful selection of the most suitable aggregates and the hydraulic binder—LUMNITE—that made Castable Refractories possible. You can get different types of Castables to meet different temperature and insulation requirements. Refractory manufacturers sell them through their distributors throughout the country.

The Atlas Lumnite Cement Company
(United States Steel Corporation Subsidiary)
Chrysler Building, New York City

Specify **CASTABLE REFRACTORIES**
MADE WITH LUMNITE

Helpful Bulletins

BOILER PLANT EQUIPMENT

1 Refractory Selector—Handy bulletin contains selector chart for choosing proper refractory for furnace doors, arches, baffles, ash pits, etc. Also provides color scale for temperature and other working data useful to boiler room and maintenance engineers. The Wahl Refractory Products Co.

2 Self-Cleaning Stoker—New Bulletin 705 gives quick facts about the American self-cleaning hand operated stoker. One lever does all work; burns any coal; handles loads of 150 to 200% of rating. In sizes suitable for firing 100 lb. to 4000 lb. per hour. American Coal Burner Co.

3 Modern Coal Crushing—"Crushing Coal at Less Than One Cent a Ton" is the title of a new bulletin with helpful data on how to prepare and size coal for maximum boiler performance. Many charts and tables of interest to plant owners and combustion engineers. American Pulverizer Co.

4 Single Retort Stoker—Pictured in 28-page booklet are construction and operation of Detroit LoStoker, which is single retort underfeed. Contains actual figures on coal savings effected in manufacturing plants and service establishments. Detroit Stoker Co.

5 Ignition System—Bulletin outlines the Enco automatic retractable oil or gas ignition system for lighting-off pulverized coal with remote control. This system also serves as a standby for pulverized coal or other fuel when it is necessary to clear mill or feed pipes, replace fuses, etc. The Engineer Co.

6 Spreader Stokers—Helpful book on Iron Fireman pneumatic spreader stokers contains full descriptions, capacities, operating data, etc., with layouts and photos of 10 actual installations. It points the way to important fuel savings. Iron Fireman Mfg. Co.

7 Gas and Oil Burners—Type MU combined heavy duty gas and oil burners for refinery furnaces are described in 4-p. Bulletin No. 702. Complete with illustrations, the bulletin also includes data on installation and air register and information on firing with gas or oil. Peabody Engineering Corp.

8 Adjustable Water Gages—Pictured in a new bulletin are various models of Ernst split-gland adjustable water gages. Water level is visible from below and no tools required to change a gage glass. Ernst Water Column & Gage Co.

9 All Purpose Stoker—Bulletin No. 500 describes advantages of the Canton De Luxe worm feed stoker for small and medium sized industrial and commercial applications. Features include side ash dumps, extra grate area, zoned air control, dur-alloy steel hopper. Canton Stoker Corp.

10 Boiler Tube Cleaners—Hints on stepping up boiler efficiency through proper scale removal are given in Airetool Bulletin No. 14. These cleaners are equipped with non-tracking cutters to avoid tube damage; come with air, steam or water driven motors. Airetool Mfg. Co.

HELPFUL BULLETINS

Practical answers to many wartime problems of plant operation and maintenance are found in the engineering bulletins offered by manufacturers. For your convenience we publish the following summary of helpful literature mentioned in this and recent issues of POWER PLANT ENGINEERING. To obtain copies of the bulletins and catalogs described, simply indicate the paragraph numbers on postcard below, detach and mail.

ELECTRICAL EQUIPMENT

11 Electrical Connectors — Pocket-size catalog, 48 pages, illustrates 75 electrical connector types with catalog listings of important connector sizes. Also contains helpful wiring data. Burndy Engineering Co.

12 Motor Care—New handbook entitled "A Guide to Wartime Care of Electric Motors" meets pressing problem of how to keep motors running under continuous service conditions. Book should prove of value to engineers and maintenance men and in training new operators; is an impartial study of all motor types. Allis-Chalmers Mfg. Co.

13 Circuit Arrangements—8-page publication, GEA-3759, offers information to help in selection of proper arrangement of load-center distribution systems to fit individual requirements of industrial plants, shipyards, naval and military projects, etc. Bulletin also describes four basic load-center circuit arrangements. General Electric Co.

14 Air-Cooled Voltage Regulators—An 8-page Booklet B-3080 gives a quick non-technical summary of the outstanding highlights of the Westinghouse Type SA air-cooled induction feeder regulator. Included are construction details, design features and a diagrammatic sketch showing the air cooling process. Westinghouse Elec. & Mfg. Co.

15 Fluorescent Lighting—New catalog of lamps and equipment provides a complete story on the design of a system of fluorescent illumination. Over thirty types of luminaires are described. A valuable guide for engineers with industrial lighting problems. Sylvania Electric Products, Inc.

16 Synchronous Motors—Bulletin 522 covers Ideal high speed synchronous motors of bracket and pedestal type. Illustrations show typical installations in rubber mill and sewage disposal plant. The Ideal Electric and Manufacturing Co.

17 Kv-a. Metering—An 18-page illustrated Booklet B-3135 on kv-a. demand metering, explains how it can be used to get the most out of existing generating and distribution facilities; outlines the most recent developments in kv-a. demand metering and also explains several applications. Graphs and line diagrams show the accuracy and practicability of the various types of kv-a. meters. Westinghouse Elec. & Mfg. Co.

18 Electric Power Guide—A handy engineers' pocket size guide, GED-1006, gives information on how to save time and vital materials in getting reliable power to new production machinery by quickly installing electric power systems in new plants and plant extensions. Well illustrated with typical applications, the guide also includes advantages and specifications of equipment. General Electric Co.

19 Saving Copper — Catalog GED-1011, a timely up-to-the-minute presentation, deals with conservation of a vital war material under the title of "Five Ways to Conserve Copper in War Plant Electrical Systems." Many helpful charts and wiring diagrams. General Electric Co.

19B Lighting Guide—Up-to-the-minute information of the use of fluorescent luminaires for factories and offices is given in new lighting catalog. Includes diagrams, specifications, price lists. Martin-Gibson Light & Tile Corp.

FANS, PUMPS AND COMPRESSORS

20 Pump Manual — The Stationary Instruction Manual is a 12-page bulletin, well illustrated and covering in detail the installation, operation and maintenance of small pumps. Text covers such points as installation, foundation bolts and grouting, alignment, suction lines, piping, relief valves, priming, starting, rotation, packing, dismantling and reassembly. Quimby Pump Co.

21 Steam-Jet Ejectors — Described in new Bulletin W-205-B5A are Worthington steam-jet ejectors of the double element two-stage type. Gives dimensions and engineering data. Worthington Pump & Machinery Corp.

22 Fans—Catalog 460 describes the new Victory Axiflo seven-bladed fan with a direct connected turbine or integrally mounted motor drive. Available in sizes for 1750 r.p.m., operation at pressures ranging from ½ to 60 in. B. F. Sturtevant Co.

23 Pumping Controls—Controllers of the recording and indicating type are shown, with specimen charts and installation photos in Bulletin B-294. In addition to waterworks and engineering information, pumping applications common to industry are detailed. The Foxboro Co.

24 Pump Design—4-page folder contains a reprint of an article entitled "Pump Design Affords Wide Scope in Application." The analysis presented by H. Gartman, on centrifugal pump performance, presupposes an understanding of how pump characteristics are affected by features of design. The influence of blade angles and of the areas of wheel passages upon the head-capacity curve is explained by diagrams. De Laval Steam Turbine Co.

25 Rotary Pumps—Pump applications and the general background of a line of rotary pumps for every industry are included in a 24-page catalog that furnishes comprehensive information on installations in plants and features of design. Blackmer Pump Co.

26 Power Saving Pumps—New Bulletin No. 65 gives full details, sizes and ratings of Aldrich-Groff "Powr-Savr" pumps. These pumps provide for automatic or remote manual control of delivery. Aldrich Pump Co.

27 Steam Pump Maintenance—Many valuable suggestions are given in new card "Pointers on Steam Pump Maintenance" which can be posted on wall for quick reference. Covers pump starting, lubrication of moving parts, care of stuffing boxes, etc. Worthington Pump & Mach. Corp.

INSTRUMENTS AND CONTROLS

28 Pyrometers—40-page Bulletin No. 1105, features design and operating features of Brown potentiometer

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pyrometer and accessory equipment. Also describes automatic control systems and explains their operation. Brown Instrument Co.

29 **Manometers**—Bulletin No. 200 describes a complete line of Simplex Standard manometers. Included are details for measurement of air, water, steam, boiler feed, and industrial liquids in the power and process industries, as well as flow, back wash, and loss of head in filter plants. Included are specification details, capacities, and method of connection, together with a reference section of useful manometer data. Simplex Valve and Meter Co.

30 **Stabilized Control**—Bulletin A-330 explains the principles and performance of Hyper-Reset, a new stabilized control function for application where process lag is considerable. Process disturbances are corrected proportionate to the rate of change of the measured value caused by the disturbance. The Foxboro Co.

31 **Handy CO_2 Analyzer** — Bulletin 338 describes simplified Firite "Orsat" analyzer. Held in hand while you make tests. A complete analysis in 40 seconds. Also tells about Fire Efficiency Finder—a calculator that converts CO_2 and stack temperature readings into heating efficiency percentages. Bacharach Industrial Instrument Co.

32 **Pressure Gauges** — Just off the press is 12-page bulletin featuring new line of Certified pressure vacuum and compound gauges. Contain table of pressure equivalents and other data useful to engineers. Certified Gauge & Instrument Corp.

33 **Instruments & Controls**—Various instruments and controls for boilers, turbines, pumps, processes, etc., are briefly illustrated and described in a 16-page Catalog No. 42-1. Included are data on application and operating features. Republic Flow Meters Co.

34 **Flow Meters**—"Centrimax Flowmeter for Steam and Water" is the title of a new 20-page Catalog N-28-160 which deals with the need to measure flow with unusual accuracy, when power efficiency is at stake, or because accounting is done on the basis of flow reading. Its application and installation in central stations and industrial power plants is also included. Leeds & Northrup Co.

35 **Differential Pressure Recorder**—Bulletin No. 195, "Bailey Bellows Operated Recorders" illustrates a differential pressure measuring device which may be used as a liquid level recorder or a flow meter. It is particularly well suited for use under high static pressures and under high differential pressures. Operates without mercury; may be used in places where mercury is objectionable or prohibited. Bailey Meter Co.

36 **Signalling Controller** — Engineering Data Sheet 39 is a 4-page mimeographed folder with wiring diagrams and data on the ATC air raid alarm controller, applicable to manual or automatic sounding of alert and all clear air raid signals for motor drive, air or steam, bells, lights, or any other signal device. Automatic Temperature Control Co., Inc.

MECHANICAL TRANSMISSION

37 **Flexible Coupling**—The story of what a flexible coupling should do and the function of the coupling is described in Bulletin 642 which also illustrates some heavy duty installations. Installation information is given together with standard key dimensions and a repair parts price list. W. H. Nicholson & Co.

38 **Bearing Metals Manual** — Fact-packed new data book shows how to substitute lead base babbitts for tin-base bearing metals; also tells engineers and maintenance men which metals to use under all bearing service conditions. Magnolia Metal Co.

39 **Conveyor Pulleys**—Solid and split conveyor pulleys are the subject of Bulletin CP-42. Well illustrated, the catalog contains complete data needed to specify conveyor pulleys in crown or straight face construction. Included are types of construction and lagging, sizes and prices. The American Pulley Co.

40 **Wire Rope Manual** — Well illustrated 82-page book, "Know Your Ropes," provides a helpful handbook on the selection, application and usage of wire rope. Contains many diagrams for splicing and attaching; also ideas for conserving the strength and life of wire rope. A valuable reference book for engineers and maintenance men. Wickwire Spencer Steel Co.

PIPING, VALVES AND FITTINGS

41 **Conduit**—Catalog S is a 12-page engineering bulletin on underground and overhead prefabricated units and tile conduit systems. Shown are typical conduit fittings, pipe supports, glands, and prefabricated expansion loops complete with engineering details and suggested specifications. The Ric-Wil Co.

42 **Trap Data Book**—"How to Choose a Steam Trap" is the title of a new convenient informative steam drainage guide, 40 pages of condensation rate charts, graphs, tables—formulas for computing condensing capacity of steam using equipment—trap sizes for unit heaters, header drips, jacketed kettles, etc., will give you all the data the title of this book infers. The V. D. Anderson Co.

43 **Metal Hose Handbook**—Bulletin No. H-201 gives complete information about Eclipse Aviation Seamless Flexible Metal Hose, widely used for handling alcohol, grease, hot liquids, oil, steam and other non-solids, where high temperature and pressures prevail, and where flexing and vibration are encountered. A helpful book for engineers, designers and specification men. Eclipse Aviation (Metal Hose Department) Division of Bendix Aviation Corp.

44 **Welded Tubing**—Electroweld steel tubing for boilers, condensers, heat exchangers and mechanical tubing is described in new folder. Solid wall structure, uniform diameter and thickness are among advantages pictured. The Oil City Tank & Boiler Co.

45 **Traps for Every Purpose**—Thermostatic, expansion steam, weight and piston operated trap types are illustrated and described in industrial steam trap Catalog 941. Typical uses and features are explained and recommended piping diagrams for various applications are shown. W. H. Nicholson & Co.

46 **Pipe Joint Compound** — Bulletin outlines uses and advantages of X-Pando pipe joint compound on iron, steel, brass, copper or soft metal pipe. It expands as it sets. Also used to assemble Diesel engines, superheaters, condensers, pumps, valves, meters, etc. X-Pando Corp.

47 **Valve Reseating Machines**—New Catalog 40—32 pages—offers complete explanation of construction and operation of valve reseating machines for either gate, globe or pump valves. Easily operated, reliable, efficient and durable, these machines save valves from discard many times. The Leavitt Machine Co.

48 **Welding Fittings**—Bulletin WF-41 gives complete and interesting information on welding fittings (ells, tees, flanges, nipples, return bends, etc.) that improve design and reduce cost of piping systems. New American Standard for butt welding fittings is also listed. Midwest Piping & Supply Co., Inc.

49 **Modern Tube Cleaners**—New Bulletin No. 62 describes most popular types of Wilson cleaners for removing scale, coke, sludge or gum. Shows motors, cutter heads and accessories recommended for various tube cleaning problems; gives cleaner sizes and specification data. Thomas C. Wilson, Inc.

50 **Flexible Piping**—New 8-page Bulletin 71 furnishes standard data for Penflex, all-metal flexible pipes for Diesel installations, exhaust pipes, air intakes and supply lines. Pennsylvania Flexible Metallic Tubing Co.

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51 Iron Piping—Toncan iron pipe for tough service is the theme of a 48-page illustrated catalog in color describing the history, properties and applications of Toncan iron pipe, with outstanding service records under severe conditions in a number of specific fields. In addition the bulletin includes data on the properties, both chemical and physical, fabrication data, welded sections, and fittings. Republic Steel Corp.

52 Automatically Tight Joints—Attractive 6-page bulletin tells about ability of Auto-Tite connectors and joints to take excessive strains. Made for standard and high pressures of steam, air, water, gas; help insure low-cost operation in air compressors, steam turbines, portable water meters, stuffing boxes, etc. Superior Railway Products Corp.

53 Valves and Specialties—Lunkenheimer Catalog 78—136 pages, flexible cover—includes a comprehensive representation of bronze, iron and steel valves, boiler mountings, lubricating devices, air devices and other specialties. In addition to the technical and dimensional data, there is a section on the thermodynamic properties of steam, and a table of shipping weights. The Lunkenheimer Co.

54 Steam Trap Handbook—New 8-page book "Service Guide and Wartime Conservation Suggestions for Steam Trap Users" is a valuable addition to every engineer's library. Packed full of ideas on trouble shooting, and proper maintenance. Many charts and drawings. Armstrong Machine Works.

55 Piping Pointers—How to pull up a valve, how to rod out tarry fluid lines, and many other helpful "kinks" that make piping maintenance easier are given in the Crane bulletins "Piping Pointers." They're ideal for shop or classroom use. Crane Co.

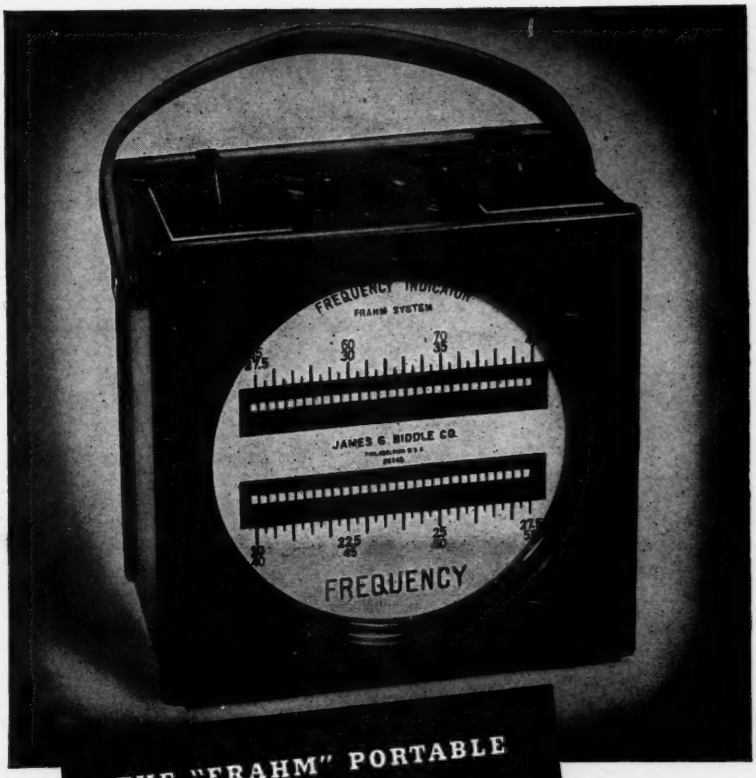
56 Butterfly Valves—Catalog No. 10B, 16 pages, features standard and special butterfly valves for the control and tight shut-off of air, gas, steam, liquids and semi-solids under high and sub-zero temperatures and varying pressures from 2 to 300 p.s.i. Contains performance characteristics under all conditions of service, manual and automatic control, specifications and flow charts. R-S Products Corp.

57 Metal-Saving Conduit—Ways to save metal by enclosing underground lines in non-metallic Thermo-o-tile are described in helpful Bulletin 381. Has monolithic concrete base, no broken stone fill. H. W. Porter & Co.

58 Silver Brazed Joints—Bulletin FSV tells how Faircoseal valves are designed to make a silver brazed joint with brass or copper pipe and tubing. These valves, with heat-resistant Silbraz joints, are designed for use with steam, oil, hot or cold water, compressed air, acid, Freon, etc. The Fairbanks Co.

59 Steel Fittings Handbook—New Bulletin A-3 offers 44 pages of useful information on forged steel fittings. Includes 100 illustrations, 78 drawings, many basic engineering tables, charts and data. The Watson-Stillman Co.

(Continued on Page 128)



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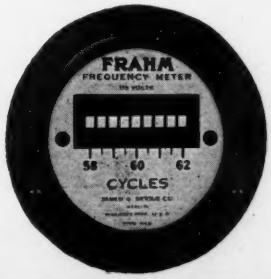

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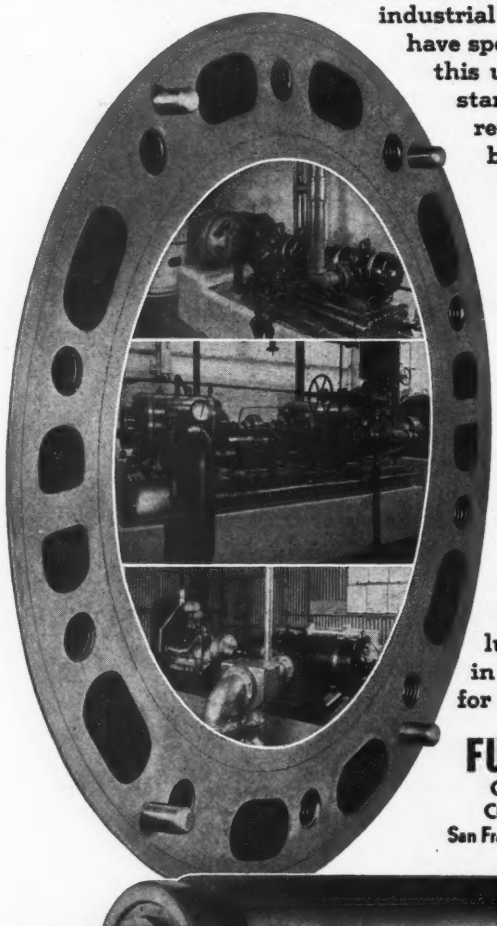

Simplicity makes for reliability and, one of the outstanding features of a Fuller is simplicity of design . . . only three moving parts—rotor, bearings, blades. Other features and advantages of Fuller Rotary Compressors and Vacuum Pumps are illustrated and described in Bulletin C-5. Write for a copy today.

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60 Silent Check Valves—New Catalog No. 140 covers construction and advantages of Williams-Hager silent check valves for pump lines. Also illustrates pump valves, pump governors, traps, water columns and other specialties. The Williams Gauge Co.

WATER TREATMENT

61 Water Treatment — Corrective Chemical Feeding is the title of a new 12-p. Bulletin 101-B, which contains helpful technical data on problems of corrective chemical feeding for water refining and gives a guide as to the proper type of equipment selection. American Water Softener Co.

62 Chemical Feeders — Illustrated bulletin explains applications of Pulsafeeder for accurate feeding of corrosive and non-corrosive chemical solutions. Adapted to proportioning problems of corrosion control, water conditioning, pH control, boiler feed, etc. Wilson Chemical Feeders, Inc.

63 Condensate Corrosion Control — Case history data on condensate corrosion control by the Haering Process of direct introduction of chemicals into the steam has been released in a 6-page pamphlet which tells the story of a severe condensate corrosion condition in the Cook County Nurses Home where double extra heavy wrought iron piping failed in 30 da. service. D. W. Haering & Co., Inc.

64 Boiler Water Problems—"Technical Water Conditioning System for Boilers" is the title of a new 12-page bulletin covering boiler water problems and their treatment. Includes chart showing money lost with boiler scale of varying thicknesses. Water Treatment Company of America.

65 Feedwater Treatment — 4-page folder introduces Tanalginate, new protective and reactive colloidal material for conditioning boiler feedwater. Product is used in conjunction with such inorganic chemicals as phosphates or alkali. The Bird-Archer Co.

66 Water Clarification — There are many places in which the clarification of water is highly desirable. It may be through pressure filters; for beverages, cooking or process work, swimming pools, ice plants or oil removal filters. Nalco Bulletin No. 29 tells how this is accomplished at low cost. National Aluminate Corporation.

MISCELLANEOUS

67 Industrial Plastics—New 16-page bulletin contains helpful information on general properties of extruded industrial plastics; special and stock shapes; many wartime uses in replacing rubber, brass, aluminum, copper, bronze and steel. R. D. Werner Co., Inc.

68 Conservation Folders—Pamphlets show how to make equipment last longer. Among the titles already issued are, "How To Make Your Thermometers Last Longer" and "How To Make Your Safety and Relief Valves Last Longer". Suggestions will be helpful even on competitive products. Manning, Maxwell & Moore, Inc.

69 Plastic Insulation—Bulletin No. 327-D, 8 pages, covers Insulag, a refractory plastic insulating lagging for use on high- or low-temperature equipment. Ideal for covering turbines, feedwater heaters, hot liquid storage tanks, stacks, pipes and flanges. Quigley Co., Inc.

(Continued on Page 130)

You'll want this latest "PIPING POINTERS" BULLETIN

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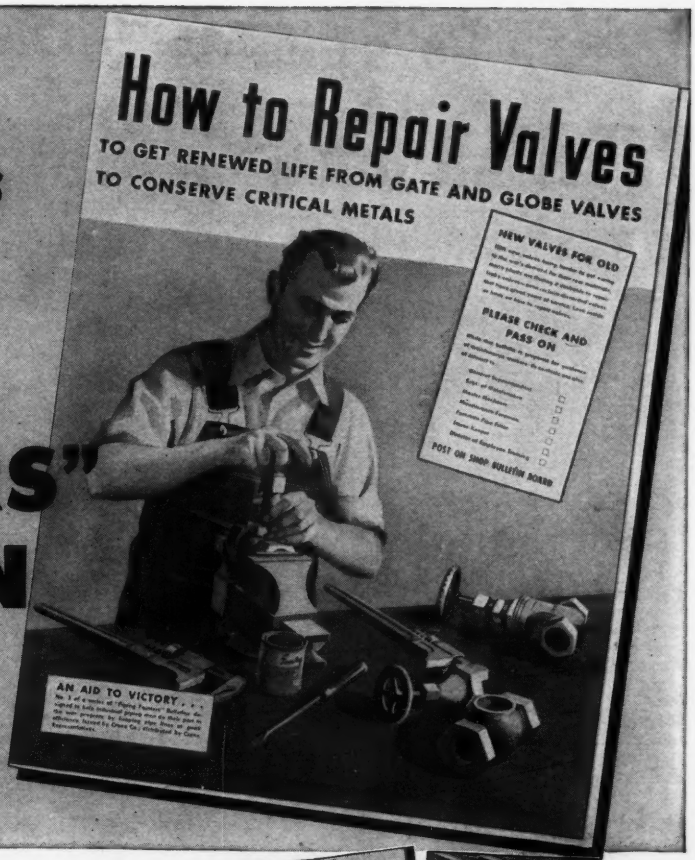
How to Repair Valves
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2. Bulletin No. 5 deals specifically with proper repair and reclamation of valves; tells how to keep them working better and longer. That's mighty important—now when piping equipment is harder to get—and critical metals must be conserved for war.

3. "Piping Pointers" are ideal for training and supervising the new men required to keep plant equipment in shape under triple-shift operation. Also, they help keep veteran workers "brushed-up" on modern piping practices.

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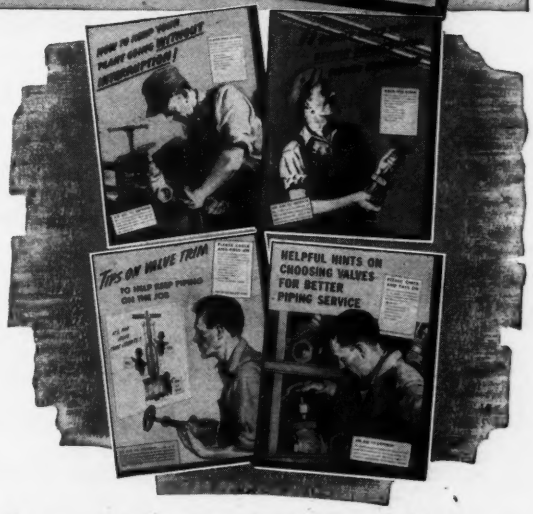

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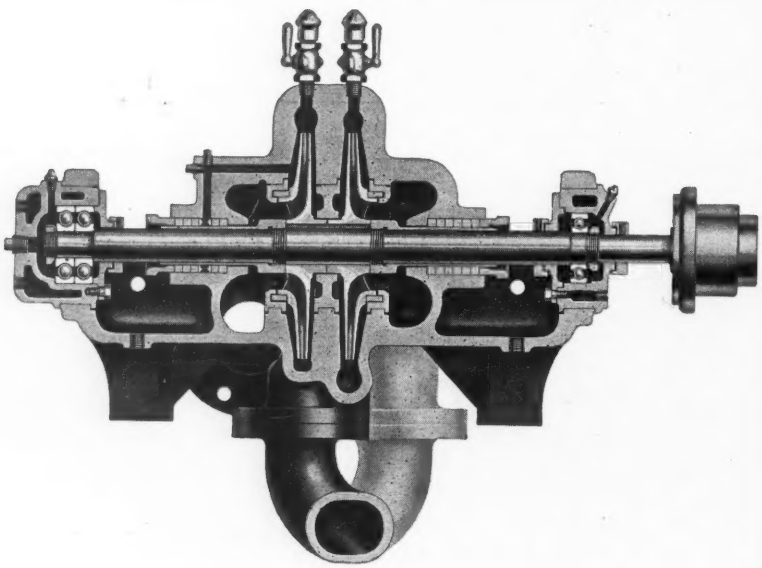

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Warren Steam Pump Co., Inc., Warren, Mass.

70 Packings — Sixty-four page catalog illustrates and describes a comprehensive line of packings, gaskets, gasket and lubricating pastes, etc. Reference to text and recommendation tables will enable you to select a satisfactory material for any packing job. The Garlock Packing Co.

71 Free Repair Handbook — A 40-page guide to the use of Smooth-On cements contains 170 diagrams and instructions for making lasting and economical repairs to plant equipment and machinery, pipe lines, fixtures, etc. Smooth-On Mfg. Co.

72 Rubber Conservation — 48-page rubber-conservation manual discusses ways and means of making the present supply of rubber goods for civilian use last longer. Among the products discussed are: hose, transmission, conveyor and elevator belts, mechanical packings, electrical tapes, wires and cables. U. S. Rubber Co.

73 Clarifying System — 4-page folder describes continuous circulating intercepting and clarifying treatment system for cutting oils and coolants. Piping diagram shows how system works in clarification. Gale Oil Separator Co., Inc.

74 Refractory Concrete — 24-page book features characteristics of Lumnite, methods of making refractory concrete, heat-resistant concrete and refractory-insulating concrete. Book contains many photographs and tables. Atlas Lumnite Cement Co.

75 Heat Insulation—New 16-page illustrated catalog covers an expanded line of BH heat insulation products from blocks and blankets to building insulation materials. Methods for application are detailed and calculations facilitated by several charts showing the temperature heat loss and insulation thickness relations. Baldwin-Hill Co.

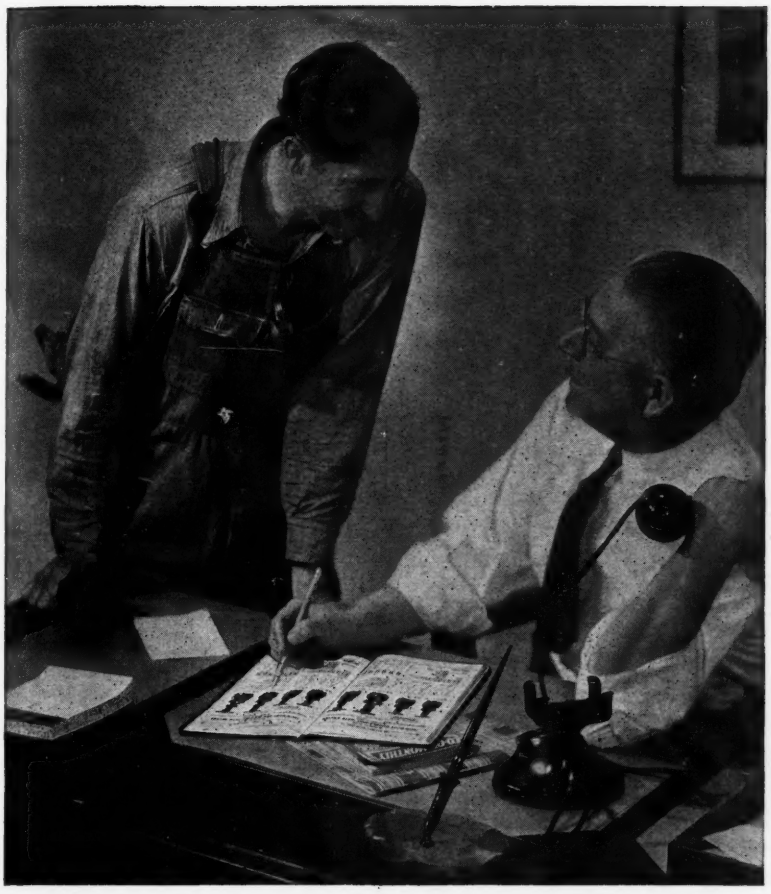
76 Material Handling—New Catalog 427 describes electric vibrators for speeding up flow of material in powdered wet coal chutes, foundry sand chutes, sand bends, etc. Also tells about feeder machines, shaft seals for pumps, pipe couplings, electric hammers. Syntron Co.

77 Insulation Guide—Handy file-size folder is packed with useful information on asbestos, magnesia and other heat insulation for power and industrial plants. Specific recommendations for jobs from subzero to 2100 deg. F. Many charts and tables make this a valuable addition to every engineer's library. The Ruberoid Co.

78 Alloy Steels—Bulletin No. 642-C is a 24-page catalog on Amsco manganese steel for crusher, grinding mill and pulverizer parts. Included is data on the characteristics of manganese steel with sections of the book devoted to typical parts used in various types of equipment and in typical services. American Manganese Steel Div., The American Brake Shoe & Foundry Co.

79 Automatic Weighing Scale—No rotating parts, high weighing accuracy, minimum dust hazard, quiet operation and long life are features of the new Beaumont Vibro automatic weighing scale pictured in a recent bulletin. Also gives overall dimensions and general specifications. Beaumont Birch Co.

(Continued on Page 132)



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The new Kennedy Catalog describes the entire line of bronze and iron body valves of all standard types, also malleable iron, bronze and cast iron pipe fittings. Write for your copy.

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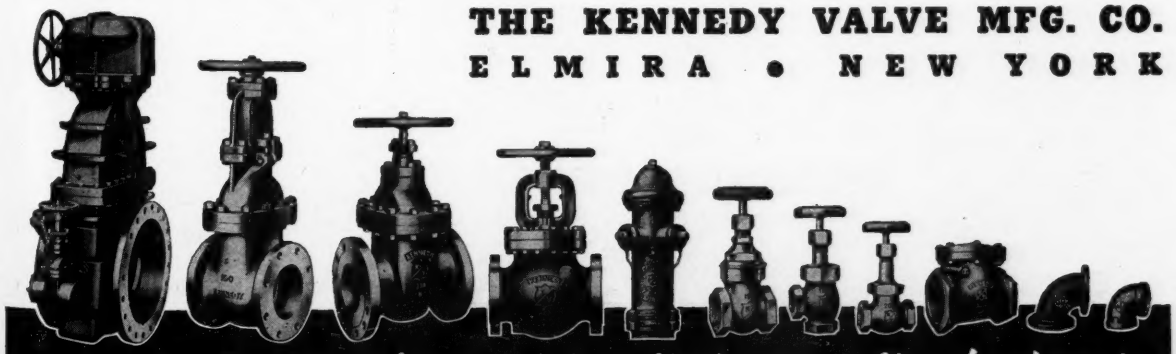


KENNEDY *valves . . . pipe fittings . . . fire hydrants*

80 Building Maintenance Handbook—74-page handbook has practical information for plant managers, maintenance men and superintendents. Shows how to do many odd jobs at lower cost with better results. Over 150 pictures, diagrams and drawings. Non-technically written. Flexrock Co.

81 Direct Fired Heaters—New Bulletin 506 covers Dravo direct fired heaters. Many charts and tables deal with savings in fuel, manpower and critical materials. Dravo Corp.

82 Substitute Material—One of the answers to the critical materials shortage is given in a 12-page Booklet, B-3121, on Prestite, a ceramic plastic, telling what it is, how it is made and how to use it. A description of the manufacturing process is given with several applications, and mechanical and electrical characteristics. Also included are design suggestions. Westinghouse Elec. & Mfg. Co.

83 Power Check Chart—"National Power-Recovery Plan" is the title of a booklet describing a plan to stimulate the reduction of industrial power losses, whether you purchase your power or generate it. Containing a series of estimators, each relating to a certain phase of power service, you are enabled to report every possible power leak which can be corrected in various departments. L. H. Gilmer Co.

84 Conveyor Data Book—Data Book No. 200 contains 124 pages, is packed full of helpful ideas for conveying coal, ashes and other materials. Shows how to combine special and standard conveyor designs for economy. Gifford-Wood Co.

85 Welding Chart—An arc welding inspection chart presents graphically different types of welds obtained when the work is done normally, with proper current, voltage and speed, as compared with those obtained under abnormal conditions. It also illustrates the Fleet-Fillet technique of welding and shows how the speed of welding increases as the size of the electrode is increased. The Lincoln Electric Co.

86 Wartime Lubrication—"Helping Industry Help America" is the title of an impressive 16-page booklet aimed at obtaining maximum production of war goods in plants now converted and tooled up for this job. It tells how competent engineers step in and step up production in all industries. Case studies show how the proper application of petroleum products has increased production, eliminated shutdowns, reduced maintenance. The Sun Oil Co.

87 Coal Pile Protection—Recent bulletin explains use of Hot Spot indicators to guard against spontaneous combustion of stored coal. Patented fuse blows and warning signal is given when temperature reaches 150 deg. F. Coal Specialties Co.

88 Oil Handling—Industrial Equipment Catalog is the title of a new 40-page booklet covering Bowser oil handling, filtering, condititoning equipment, mechanical forced feed lubricators, sight flow devices, check valves, fittings, meters and accessories, strainers, flow control, and dispensing equipment. S. F. Bowser & Co., Inc.

89 Welding Conservation—A 14-page booklet, which consists of a series of six shop posters, is designed to help arc welding operators do more useful work with every electrode. Each poster illustrates a common wasteful practice, then points out the ease and simplicity of doing the job the right way. Posters are bound securely into the booklet and can be easily detached and tacked on shop bulletin boards. Air Reduction Sales Co.

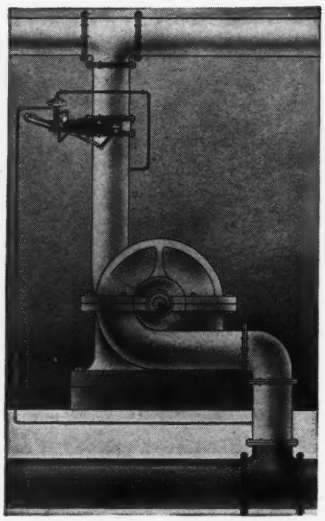
90 Industrial Insulation—Attractive 8-page bulletin deals with applications and advantages of several types of Fiberglas for steam pipes, hot and cold water lines, tanks, boilers, hot air ducts, refrigeration, etc. Contains useful installation data. Owens-Corning Fiberglas Corp.

91 Coal Field Story—Beautifully illustrated 24-page book describes the mining, preparation, uses of coal from Pittsburgh seam in West Virginia. Contains many boiler diagrams, helpful data on fuel burning efficiency. Coal Bureau, Upper Monongahela Valley Assoc.

92 Air Raid Siren—4-page Bulletin 29 gives timely information on installation and diagrams of the features built into Foster air raid sirens. The bulletin also describes its operation and its application to other systems besides air raid signalling. Foster Engineering Co.

R-S QUALITY PRODUCTS SINCE 1908

125-lb. R-S Butterfly Valve, equipped with hydraulic cylinder for automatic operation, serves a triple purpose where a pump or battery of pumps discharges into a common header. Prevents a synchronous-driven pump from grabbing all the load when the pump is started, prevents reverse flow through the pump and eliminates water hammer.



AUTOMATIC BUTTERFLY VALVE

- **Protects Pumping Unit**
- **Prevents Water Hammer**

For example, with 55 p.s.i. in the common header and a 2 lb. lift, a differential control utilizing the hydraulic cylinder, would be set for approximately 56 lbs. The Butterfly Valve remains open as long as a greater differential than 56 lb. is maintained.

In case of pump or power failure, the flow through the pump reverses. The natural tendency of an R-S Valve is to close itself under a pressure drop. The differential now drops below 56 lbs. and the cylinder closes the valve wedge-tight. It will remain closed until the pressure differential is regained. When this takes place, the valve opens gradually and normal pumping operations are resumed.

Closing of the valve causes no water hammer since the valve can not move any faster than the bleeding of the cylinder discharge permits.

Declutching unit with self-locking hand wheel control also available. Sizes to 84-inches and pressures to 600 lbs.

R-S Butterfly Valves provide *simplified regulation and wedge-tight shut-off of volume and pressure.*

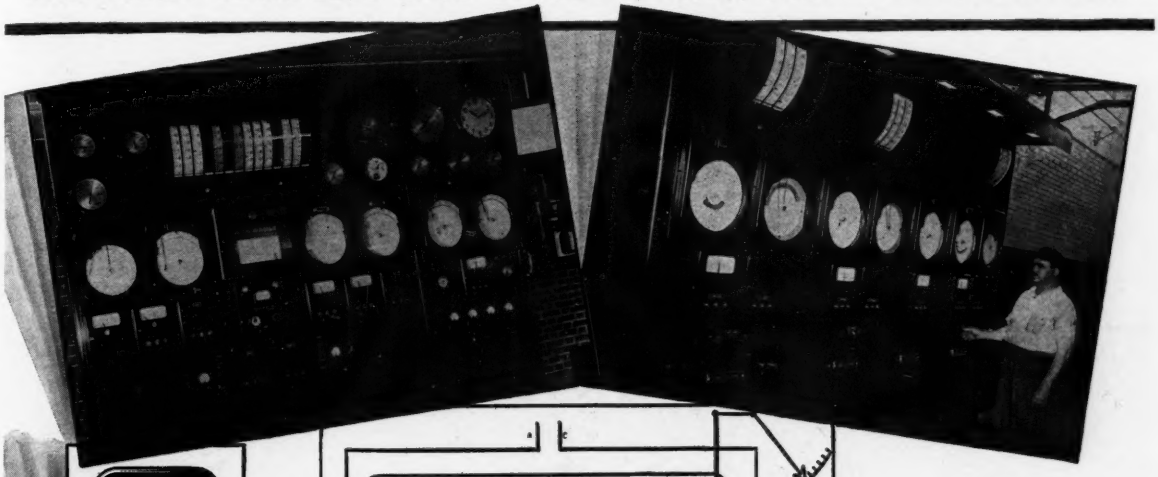
R-S PRODUCTS CORPORATION
4535 Germantown Ave. Philadelphia, Pa.

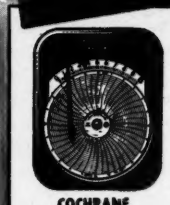
Write for catalog No. 10-B and detailed information.

R-S Streamlined BUTTERFLY VALVES

COCHRANE FLOW METERS

THE MOST COMPLETE LINE OF FLOW MEASURING INSTRUMENTS

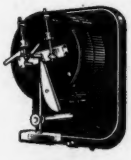




COCHRANE ELECTRIC METER

COCHRANE MECHANICAL METER

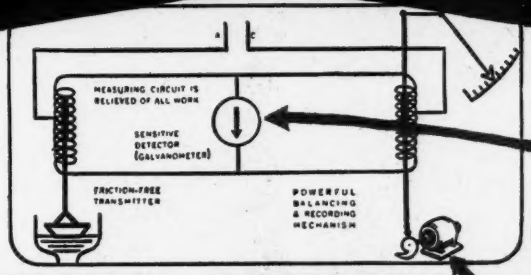
COCHRANE LINAMETER



COCHRANE RING BALANCE METER

COCHRANE LIQUID LEVEL METER

COCHRANE WEIR METER


MEASURING CIRCUIT IS RELIEVED OF ALL WORK
SENSITIVE DETECTOR (GALVANOMETER)
FRICTION-FREE TRANSMITTER
POWERFUL BALANCING & RECORDING MECHANISM

AMPLE POWER

Directed by a

PILOT

That's the principle of the NULL BALANCE METHOD

employed in the

COCHRANE

Friction-Free Flow Meter

THE null or zero balance method consists in balancing the unknown quantity by adjusting a known quantity of the same kind, a highly sensitive detector being used to determine the point of balance.

A friction-free transmitter serves as the pilot for an external motor drive which restores the electrical bridge to balance and operates pen, indicator and integrator with high and equal power throughout the entire scale.

NOTE: A bridge circuit alone is *not* a null method meter. A galvanometer is required to detect unbalance and an external source of power is needed to restore balance. These are found ONLY in the Cochrane Electric Flow Meter.

Send for 56-page "Flow Meters by Cochrane"

COCHRANE CORP., 3123 N. 17th ST., PHILA., PA.

Cochrane

Perception Test for Color Blindness

BECAUSE 4 per cent of all males and one-half of 1 per cent of all females are color blind, plant managers, personnel men and industrial physicians will probably be interested in a new color perception test recently announced by the American Optical Co., Southbridge, Mass.

Many workers such as inspectors, research men, truck drivers and railroad men should have faultless color perception for safety and efficiency, and this important element of sight can only be ascertained by an accurate color perception test. In most cases, it should be remembered, the victim of color blindness is not only unaware of his condition, but will not be convinced unless given an authorized test.

The color perception test is especially devised for ease of operation and universal application. Bound in blue cloth with gold lettering, the 46 test plates are arranged so that malingerers are quickly detected and ordinary blue and green cases of color blindness may be discovered by using not more than two or three charts. The extent of the weakness of color perception is indicated by a single reading of several key plates. A small instruction handbook accompanies each test which can be given by anyone with the aid of the book.

FASTER TUBE CLEANING INCREASES WAR PRODUCTION USE WILSON TUBE CLEANERS

The prevention of *all* waste is now not only "good business"—it is a national duty. Boilers must operate at their maximum efficiency and for longer periods between cleanings than ever before. Every pound of coal—every gallon of fuel oil—used for generating steam that *can* be saved *must* be saved and tube cleaning time *must* be reduced to the minimum. One of the surest ways to reduce both fuel consumption and tube cleaning time and also to keep boilers on steam longer is to use Wilson Tube Cleaners. They clean tubes *better, faster* and *more economically* because they have *more power, more speed, use less air* and *last longer.*

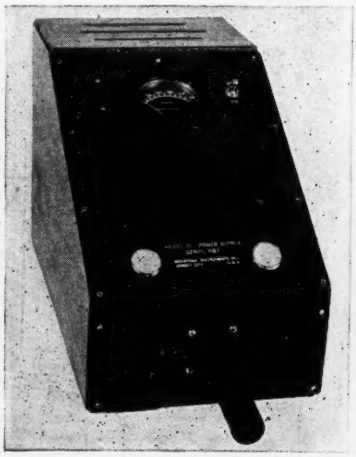
There is a Wilson Tube Cleaner, cutter head, brush or other accessory for *quickly* and *thoroughly* cleaning *any* straight or curved ferrous or non-ferrous tube of large or small diameter.

Write for the name of our representative nearest to you or ask for a copy of our NEW forty-page catalog which fully describes and illustrates the complete line of Wilson tube cleaning equipment.

THOMAS C. WILSON, Inc.
PIPE AND TUBE CLEANERS EXCLUSIVELY
47 28 37th Street Long Island City, N. Y.

Voltage Breakdown Tester

A NEW means of testing voltage breakdown of materials or components is offered by the Voltage Breakdown Tester announced by Industrial Instruments, Inc., 156 Culver Ave., Jersey City, N. J. Housed in a neat, sturdy metal cabinet with sloping panel, the instrument consists essentially of a step-up transformer accurately controlled by a variac; current-limiting resistors safeguarding the equipment in the event of a dead short; a relay indicating by means of a panel light when there is a breakdown; a meter providing direct-reading voltages; and the rectifier and filter circuit providing the high-voltage d.c. A self-incorporated safety switch makes the power supply inoperative if chassis is removed from case or otherwise disturbed.



The high voltage is applied by means of a suitable fixture or again by a test prod connecting with proper receptacle on the instrument panel, as well as by a second connection to the ground binding post on the panel. The instrument connects with the usual 110-v. 60-cycle a.c. A ground clip goes on nearest grounded conduit or water pipe. A power switch turns the instrument on an off. To set the instrument for test, the variac is rotated counter-clockwise until desired voltage is indicated on the meter. When material or component is tested, a warning light on the panel flashes on to indicate breakdown. A second light indicates that the instrument is alive. The tester is available in two models, Type P-1, 0-4000 v. d.c., and Type P-3, 0-10,000 v. d.c., both continuously variable over the entire range.

Convectors with Non-Metallic Cabinets

To CONSERVE critical material suggested by the WPB, The Trane Co., La Crosse, Wis., has perfected a new non-metallic cabinet convector to be used in place of all-metallic convectors and radiators. Except for the screws, the cabinets are constructed entirely of non-metallic materials. Side and top panels are fabricated from rigid fibre board. Supporting members provided at the corners are of hard wood.

The element of the non-metallic cabinet convectors is constructed of steel fins and tubes. The small amount of

PACKINGS chart a course to Victory!

RECOMMENDATION CHART FOR THE USE OF BELMONT PACKINGS

APPLICATION	RECIPROCATING RODS AND PLUNGERS	CENTRIFUGAL AND ROTARY SHAFTS	GLOBE AND ANGLE VALVE STEMS	SHEET PACKINGS	GASKETS
	Style	Style	Style	Style	Style
STEAM High Pressure 340°F. and over	30 Asbestos Spiral Rubber Back 47 Asbestos Spiral Rubber Center 866 Semi-Metallic 745 Braided Asbestos Square 329 Asbestos Hollow Center	745P Square Braided Asbestos 2056 Shredded Metal, Cotton Covered 4000 Plastic 4010 Plastic (over 550°F.)	655 Braided Asbestos, Vulcanized 610 Braided Asbestos, Lubricated 740 Twisted Asbestos, Lubricated 4000 Plastic 4010 Plastic (550°F.) 2001 Shredded Metal (up to 550°F.)	590 Compressed Asbestos 591 Compressed Asbestos 595 Compressed Asbestos 603 Woven Asbestos W.I. 611 R. & B. Woven Asbestos W.I.	589 Compressed Asbestos 588 Compressed Asbestos 596 Compressed Asbestos 625 Woven Asbestos W.I. 629 R. & B. Woven Asbestos W.I.
STEAM Intermediate and Low Pressure under 340°F.	319 Hollow Center 1000 Cross Expansion 102 Extra Rubber and Duck 2 Expansion Channel 203 Combination Diagonal H.P. 204 Combination Diagonal 85 Combination Set, High Speed	745P Square Braided Asbestos 2056 Shredded Metal, Cotton Covered 4000 Plastic 2001 Shredded Metal	610 Braided Asbestos, Lubricated 740 Twisted Asbestos, Lubricated 4000 Plastic 2001 Shredded Metal	602 Black Sheet	642 Black Sheet

While these recommendations are based on years of experience, no guarantees are made in view of the many peculiarities that may center around one application as compared with another of similar nature. Consult with us for special or unusual services.

VICTORY is the target at which we're shooting, and though it's only nine months since the scrap began . . . production, the big gun of America, is now scoring bulls' eyes.

Spouting from the assembly lines throughout the Nation are the planes, guns, tanks, ships and other essentials so necessary to this all-out war effort. To keep these weapons pouring forth is the job that faces industrial America today.

Men are working longer, machines harder. Under this terrific strain wear in equipment is bound to be more prevalent. Extra precautions must be taken or vital parts are apt to go, losing time our most precious asset in this battle of mechanization.

Packings play their part in this gigantic production program. This advertisement is published as an industrial service to help save your time when a packing selection must be made. If the problem is steam, this chart will guide you in making the proper Belmont Packing selection to meet your requirements.

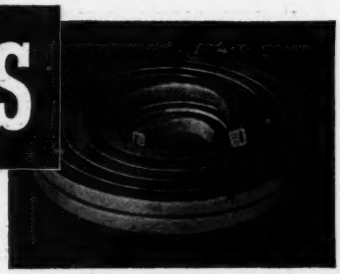
THERE'S A BELMONT PACKING FOR EVERY SERVICE . . . Steam, Water, Oil, Gas, Air, Acid, Alkalis, Ammonia. FORMS INCLUDE . . . Rings, Coils, Spirals, Reels, Spools, Sheets, Gaskets.

Belmont Packings are Sold by Authorized Belmont Distributors in Every Large Industrial Center

THE BELMONT PACKING & RUBBER CO. — BELMONT — PHILADELPHIA, U.S.A.

● For those desiring more detailed information the Belmont Catalog is available. This book contains 84 pages of packing information reduced to its simplest form. All types of Belmont Packings are illustrated and described. Packing end views are pictured in large size showing minute details. Constructions, applications, tables of weights, all are included. The Belmont Packing Catalog has been prepared by packing engineers. It's a book you should not be without. Write on your Company letterhead for your copy, today.

BELMONT PACKINGS



THE BELMONT PACKING & RUBBER COMPANY
DEPT. PP-942
BUTLER AND SEPVIVA STREETS • PHILADELPHIA, PENNSYLVANIA

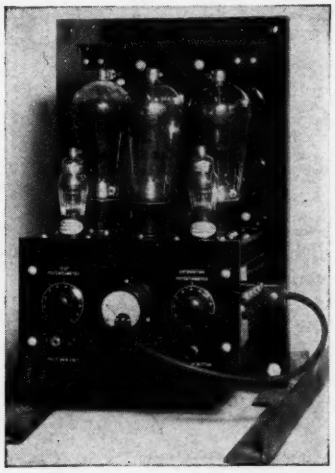
metal used in these new convectors is equivalent to 1/5 of that used in the ordinary radiator. Two cabinet types are available. One type is provided for wall suspension and the other is of the free standing floor type. Circular designed grilles are punched in the sloping tops of both cabinets.

Electronic Voltage Regulator

THE DT-5 electronic voltage regulator for a.c. and d.c. generators was announced by the Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

The voltage regulator is a sensitive electronic device which regulates the output voltage of a.c. and d.c. generators, providing the output voltage is more than 46 v. The unit operates from a 3-phase a.c. power supply and acts as a grid-controlled rectifier to supply the d.c. field current to the generator, or the exciter of the generator, being regulated. Sensitivity is ± ¼ per cent when a.c. supply voltage does not vary more than ± 5 per cent from nominal rating.

The regulator is built on a Micarta panel 1-in. thick and is designed for master panel mounting. No enclosing cabinet is provided, but the tubes are protected by a screen cover.

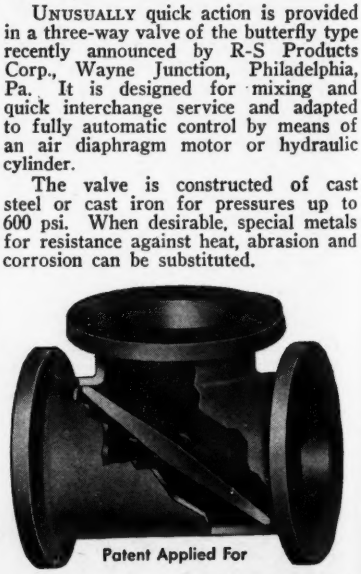


Outstanding features of the DT-5 are low maintenance, reliability of operation and a high degree of regularity. An anti-hunt circuit is built into the regulator. This circuit prevents the regulator from overshooting when close regulation is required.

Three-Way Butterfly Valve

UNUSUALLY quick action is provided in a three-way valve of the butterfly type recently announced by R-S Products Corp., Wayne Junction, Philadelphia, Pa. It is designed for mixing and quick interchange service and adapted to fully automatic control by means of an air diaphragm motor or hydraulic cylinder.

The valve is constructed of cast steel or cast iron for pressures up to 600 psi. When desirable, special metals for resistance against heat, abrasion and corrosion can be substituted.



Patent Applied For

A special feature of the valve is the self-cleaning, double-beveled, streamlined vane. It seats wedge-tight against the body of the valve, thus producing a tight shut-off as well as positive control of volume and pressure.

For inaccessible locations, a reach rod with de-clutching unit is provided for automatic operation or manual control in case of power failure.

Assembling a Fisher Type 57-S according to engineering specifications detailed on requisition at right.

OF CORRECT PERFORMANCE AND FUTURE MAINTENANCE . . .

Every FISHER Controller is individually manufactured and assembled to exactly meet your particular requirements. It is specialized equipment that MUST BE RIGHT IN EVERY DETAIL for specific operating conditions. To perfectly meet these requirements and to guarantee satisfactory performance, FISHER employs a unique manufacturing policy based on the above individual engineering requisition card.

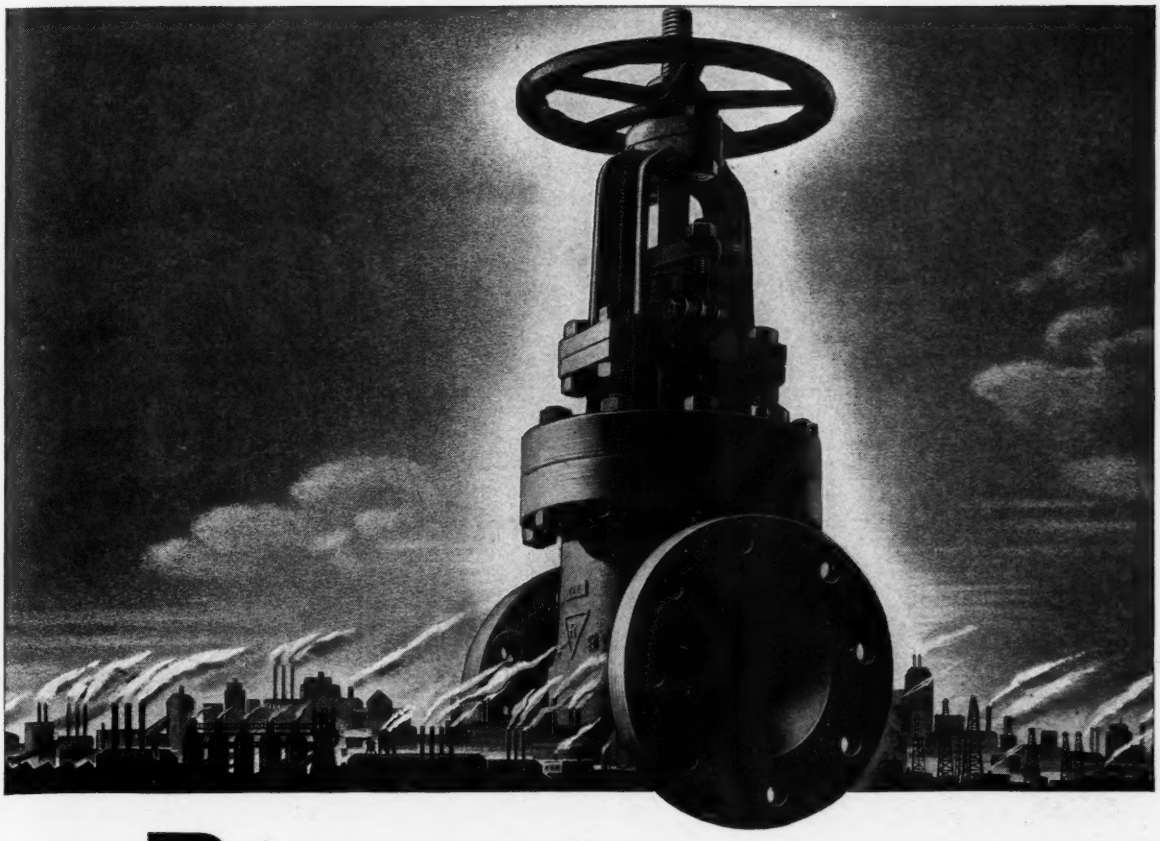
INDIVIDUALLY ENGINEERED MANUFACTURING!

Experienced FISHER engineers check sizes, capacities and determine construction details to meet the particular operating conditions specified on your order. The controller is then assigned a serial number and complete specifications placed on the requisition. The requisition card then follows that controller through the various stages of manufacturing, assembling, testing, inspection and shipping, thus assuring a correctly manufactured controller for perfect performance in accordance with your requirements.

PERMANENT MAINTENANCE RECORD!

Finally, the requisition card is placed in a permanent file by serial numbers for future reference. This permanent and complete record of all FISHER controllers provides a source of information from which maintenance parts can be quickly and positively duplicated without delay. It also provides information on the service conditions for which the valve was ordered, when manufactured, and to whom it was shipped.

FISHER
GOVERNOR COMPANY
• 1010 FISHER BUILDING •
MARSHALLTOWN, IOWA



Protect the valves you've got

DON'T use a wrench on the hex farther from the joint. A twisted body may be the result.

DON'T install a valve while it is in the open position. The chance of twisting it is lessened when it is in the closed position.

DON'T install a valve so that it will carry the weight, sag or expansion of the line. Proper supports and expansion bends or joints should be provided.

DON'T cut overlength threads on a pipe to be screwed into a valve. The pipe might shoulder against the valve seat and injure it beyond repair.

DON'T apply grease or paint to the end threads of a valve. Put it on the pipe threads and it won't get on the valve seat to collect grit or scale.

DON'T fail to blow out a new or altered line. Valve seats ruined by chips or dirt may be the penalty.

DON'T use a long lever and a strong pull on a screwed joint. A short lever and a few taps with a hammer are more effective and won't twist the valve.

DON'T try to re-assemble a valve without full knowledge of its construction. Consult the catalogue and eliminate chances of ruining the valve or of costly shut-downs.

DON'T try to re-assemble a valve with disc and stem in the closed position. A scarred seat and a bent spindle may be the result.

DON'T force a leaking valve. Usually the leak is due to foreign matter on the seat which may be cleared by opening the valve part way to flush.

DON'T use gate valve or cocks for throttling. Globes and angles are the only kinds of valves for this purpose.

DON'T install automatic stop and check valves in any but an upright position. For satisfactory operation the disc and piston must have a gravity drop.

READING-PRATT & CADY

MANUFACTURERS OF

CAST STEEL VALVES · BRASS AND IRON VALVES · D'ESTE ENGINEERING SPECIALTIES

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A DIVISION OF AMERICAN CHAIN & CABLE COMPANY, INC., BRIDGEPORT, CONNECTICUT

ROTO Offers You a Complete Boiler Cleaning Kit

Get every tool you need to clean your boilers quickly and thoroughly by ordering a complete Roto boiler cleaning kit. We can supply you with air-, steam- or water-driven motors for various sizes and shapes of tubes, and the proper types of heads for your particular kind of deposit.

This kit can also contain a Roto Pneumatic Scaling Hammer for chipping scale from drums and flat surfaces. We can furnish a wire brush with universal joint for polishing tubes after scale removal, and a brush adapted for direct connection to the motor for polishing insides of drums and outside surfaces.

If you will describe your equipment and nature of scale, we will gladly recommend a Roto boiler cleaning kit to do the entire job properly.

The ROTO Company

145 Sussex Avenue
NEWARK, N. J.

Model 130 air-driven cleaner for 3¼" curved tubes, with air valve for one-man operation.

Pneumatic scaling hammer, furnished with flat chisel, star drill and hose.

Wire cleaning brush with universal joint.

Wire cleaning brush with adapter.

SAUERMAN POWER SCRAPERS

10 to 600 tons per hour by one man

MAN-HOURS are vital these days. The Sauerman system of moving open storage coal is unique in simplicity of operation and it brings per-ton-moving costs way down. Our catalog describes this economical, trouble-free system. We would like to send you a copy.

SAUERMAN BROS., INC.
586 S. Clinton St.
CHICAGO, ILL.

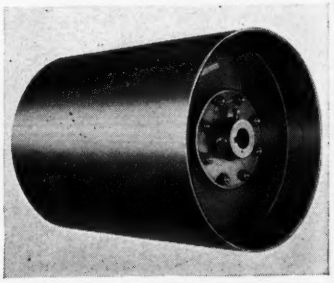
Air Raid Signalling Controller

DESIGNED to supplant manual methods for sounding 'alert' and 'all clear' air raid signals, a new signal controller unit developed by the Automatic Temperature Control Co., Inc., 34 East Logan St., Philadelphia, Pa., will automatically control operations of motor sirens, air or steam sirens, bells, lights, or any standard signal device in compliance with official civilian defense standards. Compactly housed in a dust-tight, sheet steel case, 14 by 14 by 5 in., and supplied for either flush or surface mounting positions, the controller embodies the following construction features:

Indicator lights show whether 'alert' or 'all clear' signal is in effect; a 3-pole contactor is used in the standard construction and will handle siren loads up to 25 amp. at 110 v., a.c. non-inductive; a toggle switch provides manual operation when desired; rated for operation from 110 or 220 v., 25, 50 or 60 cy.; can be supplied with an automatic throw-over inverter and stand-by battery for insuring operating in the event of a.c. power failure; and instruction plate conveniently mounted on front of case.

Tight-End Conveyor Pulley

THE AMERICAN PULLEY CO., Philadelphia, Pa., announces the American Solid Conveyor Pulley, a recent development in pulley design for belt conveyors. Made with tight ends so as



to prevent impurities from accumulating inside, the pulleys are also easily removable and have interchangeable hubs. Light weight and made of rolled steel, the pulleys are available in diameters of from 6 to 36 in.

WeldELLS

have everything ★

—here's one more example

THE major consideration in laying out your piping job may be meticulous design to meet severe service conditions—or it may simply be speed and economy of installation.

But whatever the consideration is, WeldELLS fit right into the picture—provide the correct answer in either case.

For example, it's important from the standpoint of both sound engineering and economy that pipe and fittings line up perfectly. That's why WeldELLS are given a final truing operation to bring them to exact size before machining bevel and land.

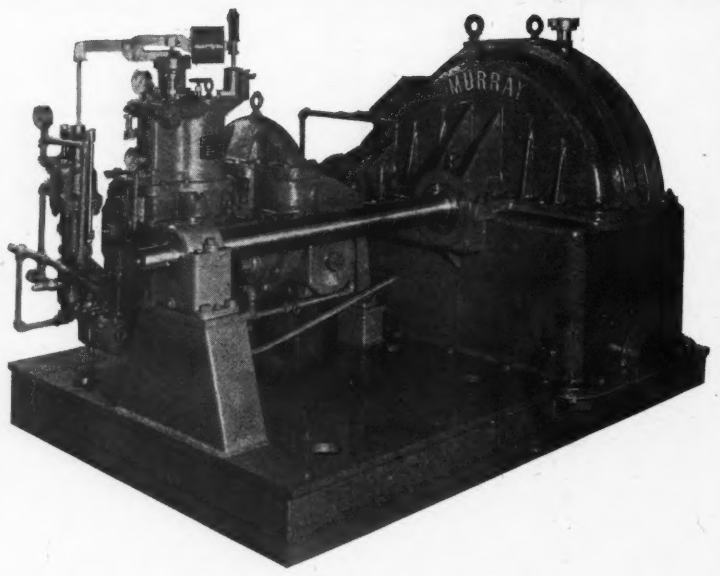
The immediate result is a more accurately dimensioned fitting; the final result, a better and more economical job.

★ No other fittings for pipe welding combine the features found in WeldELLS. In addition to extreme dimensional accuracy these features include:

- ▶ **Seamless**—greater strength and uniformity.
- ▶ **Tangents**—keep weld away from zone of highest stress—simplify lining up.
- ▶ **Precision quarter-marked ends**—simplify layout and help insure accuracy.
- ▶ **Selective reinforcement**—provides uniform strength.
- ▶ **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- ▶ **Wall thickness never less than specification minimum**—assures full strength and long life.
- ▶ **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
- ▶ **The most complete line of Welding Fittings and Forged Steel Flanges in the world**—insures complete service and undivided responsibility.

TAYLOR FORGE & PIPE WORKS, General Offices & Works: Chicago, P. O. Box 485
New York Office: 50 Church Street • Philadelphia Office: Broad Street Station Bldg.

MURRAY TURBINES



● Shows geared Murray turbine for paper mill drive. Employs Type "U" turbine with variable speed paper mill type governor, Herringbone reduction gear with low speed shaft doubly extended for mounting centrally in and arranged for direct connection to paper mill line shaft. This unit is rated at 165 h. p., 5000/400 r. p. m., operates at 190 lb. initial pressure, 80 deg. F. superheat, and 25 lb. back pressure. Located in a paper mill in Central Ohio.

Power Will Always be the Basis for Production

● **The important part played by turbines, boilers, and engines in America's war-winning production program is seen throughout our great industrial centers. Organizations that have such Murray equipment are getting the additional advantages of design developed through 70 years of experience.**

Priority ratings naturally now determine who will get Murray turbines, boilers, and engines. There is, however, a tomorrow ahead when we will all be working again under peace-time conditions.

It is for such time that we should all be planning in addition to our big production job now. Your cooperation in anticipating future needs will help greatly. Consult with our engineers even though you are not in line for quick delivery of Murray equipment.

BOILERS TURBINES ENGINES

MURRAY
IRON WORKS COMPANY
INCORPORATED 1870
BURLINGTON IOWA

BETTER SERVICE — SAFETY — SATISFACTION
FOR REPLACEMENTS ORDER

PRECISION GAGE GLASSES and GAGE GLASS GASKETS THAT WILL NOT BLOW OUT

CLEAR — Xmas — COVER GASKET — PRESSURE GASKET

Mica Shields Protectors

Standard Square Cut Gaskets High Pressure Non-hardening and Non-softening

GASKETS THAT WILL FIT EXACTLY

Red Lip-mold Pattern Expansion Type Gasket

Send for Glass and Gasket Chart

Shipment made by parcel post the same day as order is received

Standard and Extra Strong Glasses

Send for Catalog E45

Wire Glass Guards

MACHINING

ERNST WATER COLUMN & GAGE CO.
RUBBER & GLASS DIVISION LIVINGSTON, NEW JERSEY

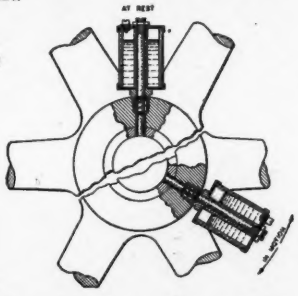
Fire Efficiency Finder

THE Bacharach Industrial Instrument Co., Pittsburgh, Pa., has developed the Fire Efficiency Finder for use with their portable Fyrite CO_2 Orsat Analyzer. The finder is a calculator that converts CO_2 and stack temperature readings instantly into heat loss and heating efficiency percentages. When the CO_2 percentage in the flue gas is determined the pointer in the calculator is moved to the corresponding figure on the scale. Then the slide is moved until the figure obtained by testing stack temperature shows in the upper right hand corner. As a result, the performance of the furnace appears in the slotted arrow—one figure showing per cent of heating efficiency, the other the per cent of total heat loss.

Loose Pulley Oiler

FOR USE on loose pulleys, idler pulleys, clutches, eccentrics, and similar rotating machine parts, a new wick type lubricator has been announced by the Oil-Rite Corp., Milwaukee, Wis. It is designed to deliver a constant, positive, and regulated amount of filtered oil to shaft or bearing while pulley is in operation, and to prevent oil waste when pulley is idle. The reserve supply of oil is always visible.

The lubricator consists of a simple glass oil reservoir, mounted on a hollow metal stem. This stem is sealed from the oil in the reservoir, except for two small ports at the very top. Inside the stem is a cylindrical felt wick, which extends through the pulley hub to rest directly on the shaft. A compression spring is wrapped around the wick to hold it firmly in position against the shaft.

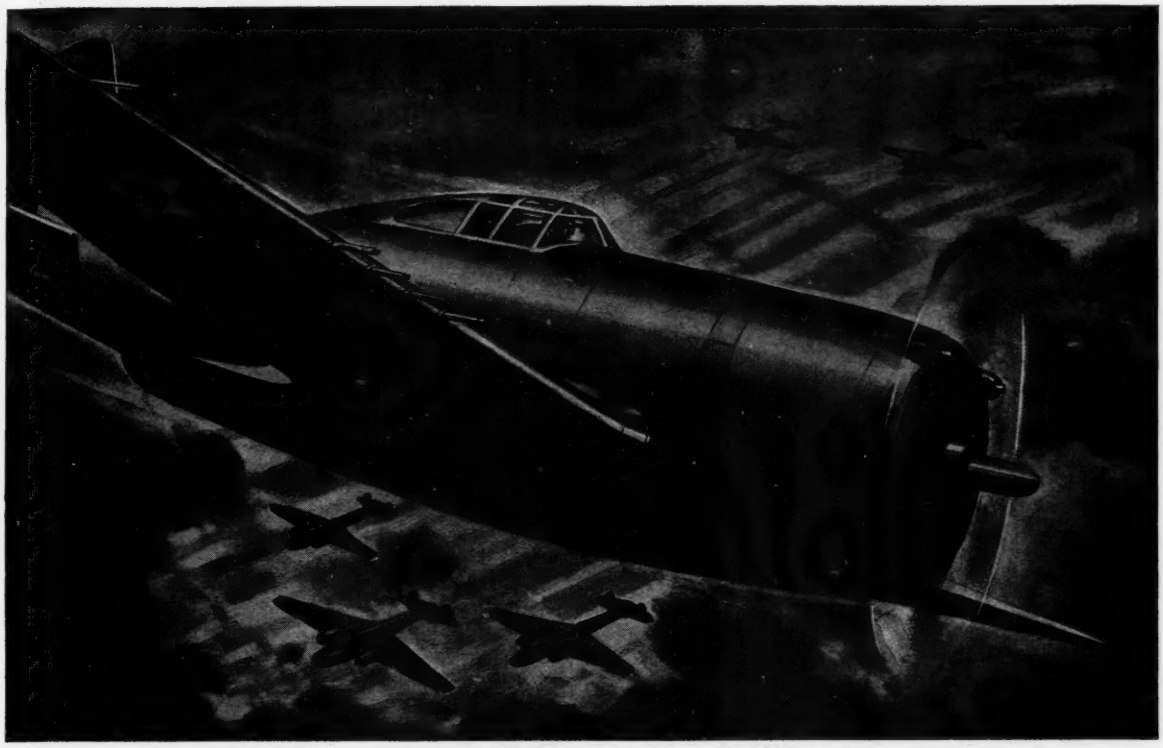


As the pulley rotates, and the lubricator with it, centrifugal force throws the oil against the top of the reservoir, and into the two ports in the stem. These admit oil to the wick, which is said filters out all dirt and sediment, and conducts the oil directly to the face of the shaft.

The amount of oil to be delivered to the shaft or bearing is regulated by means of a small plug which controls the area of the oil ports. Reservoir is filled from the top. Five standard sizes are available—capacities from ¼ to 2½ oz. for standard tappings from ⅛ to ¼ in.

Cutting Oil

SAID TO be ideal for machining aluminum and for use in machining parts for planes, tanks, ships and guns, the Gulf Oil Corp., Pittsburgh, Pa., announces a new type of oil known as Cut-Aid. The new oil is the result of 8 yr. study and experiment by Gulf specialists on animal, whale, hog and fish oil, and it is said to be excellent for cutting magnesium and non-ferrous alloys.



A Nation forges the Strength for his Wings!

NERVE and brains at controls and gun breeches — clear-eyed planning in factories at home — the two must go together. And to maintain the mighty rhythm of our production effort, many things are important. Your water supply, for instance . . .

Your plant, with improperly treated water, is susceptible to forced shutdowns for boiler repairs, fuel wastage due to encrusted boiler tubes, and impairment of the quality of finished products. Wasted fuel! Wasted man-hours! Wasted raw materials! And production must not lag today!

Graver can prevent such waste! We can solve your water-treating problems just as we've solved others for over 30 years. Check your water treating equipment today. If you have a problem, we'll analyze it for you — make recommendations — or design and build an installation — just as you wish. It's our belief that *the impact of our fighting arm depends on the strength of our industrial heart.*

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WATER SOFTENERS · FILTRATION SYSTEMS · CLARIFIERS · SEWAGE EQUIPMENT · VAPOR CONSERVATION SYSTEMS
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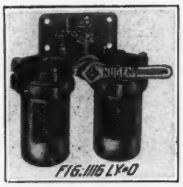
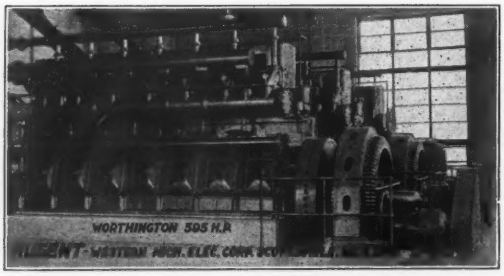
42-30-W

NUGENT *Duplex* FILTERS
Protect *WORTHINGTON DIESELS* at Scottsville, Michigan





● ***You get 20 times more actual filtering area with Nugent Duplex Filters. 20 times greater than most filters of comparable size, which means a 20 times greater interval between cleanings.***

THE Western Michigan Electric Corporation utilizes three 595 H.P. Worthington Diesel Engines as prime movers for electric generating units at their Scottsville, Michigan, plant. Here, as elsewhere, when important Diesels have to be protected against the possibility of shutdowns caused by dirt in the fuel oil, Nugent Duplex Fuel Oil Filters are installed.

Nugent Duplex Fuel Oil Filters make it easy for you to maintain continuous protection year in and year out on fuel oil lines. Far from being just "ordinary" filters, Duplex Filters are specially designed, patented units built for rugged, longlife service. Nugent's special woven, acid resisting, lintless textile filter element removes particles as small as .0003, to produce 99 8/10% clean oil. Duplex units are offered in 5 sizes For complete information and literature write.

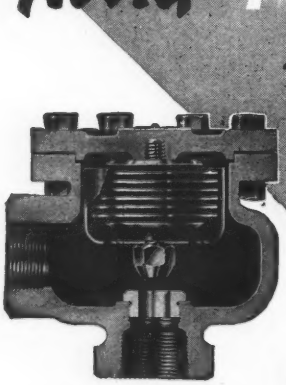
NUGENT TRADE MARK

Wm. W. Nugent & Co., Inc. Mfrs.

Oil Filters, Oiling and Filtering Systems, Telescopic Oilers, Oiling Devices
Sight Feed Valves, Flow Indicators, Compression Union Fittings, Oil Pumps, Etc.

423 N. HERMITAGE AVE. Established 1897 CHICAGO, U.S.A.

Avoid FREEZE-UPS
Install NICHOLSON
Industrial Steam Traps



Also NICHOLSON—
Welded Floats, Piston and Weight Operated Traps, Flexible Couplings, Steam Eliminators and Separators, Compressed Air Traps, Expanding Mandrels, Arbor Presses

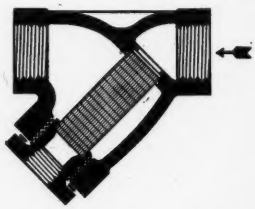
HERE is a trap that completely drains itself. It is non-freezing and non-airbinding, requires no adjustment. Ideal for outside installations or in buildings where steam is off at times during the winter.

Nicholson Traps are available in Bronze, Cast Iron and Cast Steel construction in sizes ¼ to 2 in. Good for pressures up to 300 lb. Specify Nicholsons for improved drainage of Unit Heaters, Pipe Coils, Water Heaters, etc. Write for new Steam Trap Catalog No. 941.

W. H. NICHOLSON & COMPANY
160 OREGON ST. WILKES-BARRE, PA.

Fine-Screen Strainers

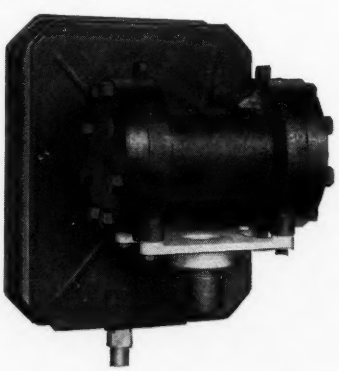
YARNALL-WARING Co., Chestnut Hill, Philadelphia, Pa., recently announced a new fine-screen strainer. Made in six standard sizes, ½ to 2 in., this strainer has three improved features: (1) plating inside and outside for protection against rusting, (2) screen of special Monel woven wire fine enough



for straining service but having ample free area, (3) straight thread and machined face on blow-off bushing for easy removal and replacement of screen and for tight joint. Iron body for pressures up to 250 lb., steel body for pressures up to 600 lb. Also are available in flanged-end design.

Flow or Liquid Level Aneroid Manometer

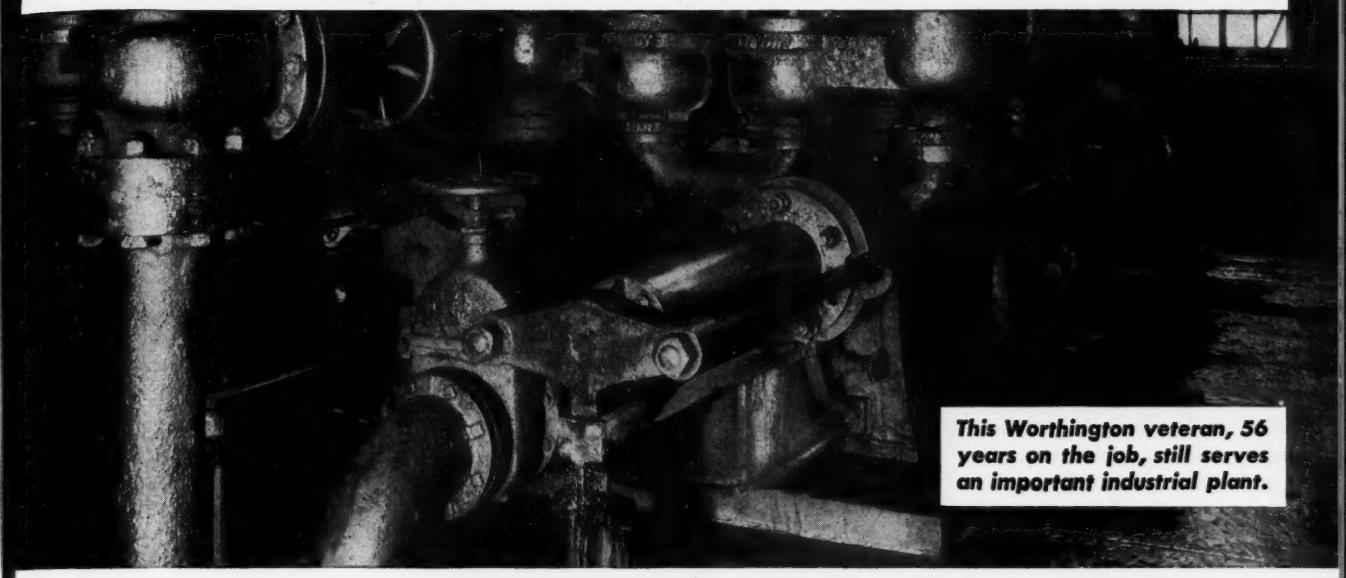
THE ABSENCE of mercury or other liquid from this latest development of The Taylor Instrument Cos., Rochester, N. Y., removes the possibility of product contamination and the hazard of mercury being blown due to line surges or carelessness. Further advantages are that sealing liquids are rarely required and vital mercury is released for the war effort.



Replacing the stuffing box is a new torque tube assembly which gives a completely closed system and is designed so as to eliminate friction and lubrication. Friction, lost motion and wear are said to be further reduced by the absence of internal pivots and springs. The metal bellows respond to the pressure variations and respond quickly under ordinary circumstances with immediate reaction to sudden changes in flow. The bellows are built to withstand high overrange.

Under steady flow conditions the manometer is said to be accurate within 1 per cent of scale range. It is available for all types of indicating and recording meters and controllers and is supplied, for standard ranges between 20 and 500 in. of water. The range can be changed right on the job by substituting precalibrated torque tubes.

Installed in 1886, and still going strong



This Worthington veteran, 56 years on the job, still serves an important industrial plant.

Careful Maintenance Will Keep YOUR Steam Pumps On the Job

YOU long-time users of Worthington steam pumps know how to keep them running and out of your years of experience have come many valuable suggestions. But, under war conditions, many of these pumps may be in the hands of inexperienced operators. These men need some simple practical guidance. Here it is.

Pointers On Steam Pump Maintenance

1. ***When starting a pump,*** make sure that valves in exhaust, suction, and discharge lines, and all steam end drain valves are open before opening the steam valve. If pump is started cold, crack the steam valve open only enough to heat the steam end, before attempting to run the pump. By allowing drain valves to remain open until the pump has made a few strokes, all condensation will be thoroughly drained off. If this is not done, serious damage to the main steam valves can result.

2. ***Lubricate all bearings, joints, moving parts, and piston rods*** before starting,—subsequently at intervals when in operation. Lubrication should be frequent, but not so abundant as to gum or clog joints. Use only a good quality of mineral oil in the steam cylinder, and a lighter grade of good mineral (or animal) oil on the valve gear.

3. ***Most pump troubles are due to fouled liquid cylinders,*** worn valves, or to conditions in the liquid pipe connections outside of the liquid cylinders. If, therefore, the pump begins to perform poorly it is possible that the trouble is in the liquid end. No adjustments should be made on the steam end until a thorough investigation shows that the liquid end is in good working order.

4. ***Liquid piston packing should be inspected frequently*** to see that it is in good working order.

5. ***Liquid valves should get occasional inspection.*** If of metal, they should be re-ground when worn.

6. ***Keep the stuffing boxes well filled with a good quality of rod packing.*** If old packing is allowed to remain in the stuffing boxes long enough to become hard, it will score the piston rod. Do not screw up the stuffing box glands too tight, as too much pressure will damage the packing and make it bind on the rod, causing scoring. An occasional drip from the stuffing box should be allowed, as this shows that the packing is not too tight and, in addition, the small leakage will lubricate the packing.

7. ***A suction strainer,*** four to five times the area of the suction pipe, should always be used when the liquid contains foreign matter that might clog valves and pump passages. It should be located where it can be frequently inspected and cleaned.

8. ***If the pump is to be left idle*** for some time, fill lubricator with oil and open lubricator cock so that oil can flow into the steam chest. Let pump make about six quick strokes to distribute the oil evenly over the inside of the steam end to eliminate danger of rusting. In cold weather, open all drip cocks, and drain all piping when pump is not in use, to prevent freezing.

If you want these *Pointers On Steam Pump Maintenance* printed in larger type on a large card, ask our nearest* district office, or address us at headquarters.

*District Offices in All Principal Cities

WORTHINGTON

WORTHINGTON PUMP & MACHINERY CORPORATION • GENERAL OFFICES: HARRISON, N. J.

WAR CHANGES
BABBITT HABITS
NEW BULLETIN
SHOWS HOW TO USE
LEAD-BASE BEARING METALS
Complete information on how to effectively substitute lead-base babbitts for tin-base bearing metals is contained in this new Magnolia manual which is packed with helpful bearing data.
Write for your FREE copy today
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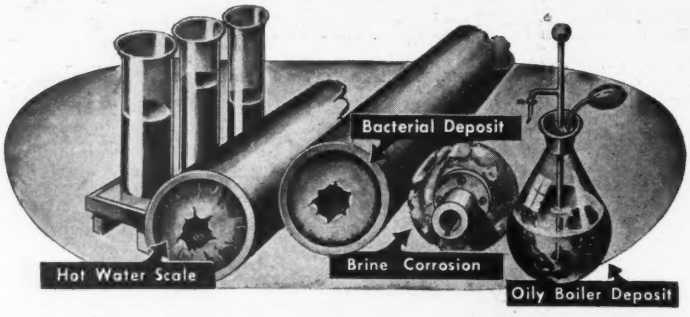
MAGNOLIA BEARING METALS



TEST TUBES SAVE WATER TUBES

Haering products and Haering service are directly stepping up war production. They control corrosion in boilers, condensers and engine cooling systems and all water equipment used in gasoline production, munitions, tanks and many other war products.

Our ability to read water and our many glucosate correctives are doing active service in war industries.

Send for booklets on scale and corrosion control, cooling waters, proportioning problems.

Write for sample containers and data forms to give us a complete picture of your problems.

D. W. HAERING & CO., INC.
"WE READ WATER"
GENERAL OFFICES: 205 West Wacker Drive
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MANUFACTURERS' PERSONALS

The York Ice Machinery Corp., York, Pa., announces the appointment of John Carr to the office of Export Sales Manager, with headquarters in the executive offices at York, Pa. Mr. Carr, formerly president of York-Shipley Co. of Shanghai, China, has been associated with the York Corp. since 1925, and replaces James C. Tweedell, recently named general sales manager for the company.

Appointment of R. J. Hearn as assistant manager of the Boston District Office of the Crocker-Wheeler Elec. Mfg. Co. has been announced by C. F. Poirier, vice-president. An electrical engineering graduate of the University of Notre Dame, Mr. Hearn joined Crocker-Wheeler 2½ yr. ago as a field engineer, specializing in the application of motors for machine tool drives. He was formerly employed by Allis-Chalmers Mfg. Co. as sales and service engineer in Milwaukee, Cleveland and Boston.

The Board of Directors of Pittsburgh Piping and Equipment Co., Pittsburgh, Pa., recently announced the election of Chas. R. Rall as chairman of the board and treasurer; L. K. Hamilton as president; Karl F. Tiegel as vice-president; Jos. G. Gardner as secretary; G. S. Larsen as chief engineer; and F. J. Hays as assistant treasurer.

John F. McNamara, mill products sales manager for the International Nickel Co. has been named chairman of the board of the Harvill Aircraft Diecasting Corp.

Mr. McNamara received his early business training at the Yale & Towne Mfg. Co's. builders hardware plant, Stamford, Conn. He joined International Nickel Co. 31 yr. ago and became vice-president and general manager of the Monel Metal Products Co. during which time he directed the sales of Monel and other special alloys.

Herbert B. Reynolds has been recently promoted to the position of Superintendent of Motive Power of the IRT Division of the New York City Transit System. The Motive Power Department comprises the 74th St. and 59th St. power stations which have a generator capacity of 400,000 kw., 26 sub-stations and the distribution system consisting of 1000 mi. of underground cable.

R. S. Neblett, assistant manager, turbine division of the General Electric Co., has been appointed to a position with the Bureau of Ships of the U. S. Navy at Washington, D. C. He will be engaged in work expediting the manufacture and delivery of geared-turbine propulsion sets for Navy ships.

Mr. Neblett, a graduate of Georgia Tech, has been assistant manager of G-E's turbine division for the past 3 yr., prior to which he had been manager of sales. He has been with General Electric since 1923.

Now Building....

36,000 SQUARE FEET LUMMUS SURFACE CONDENSER For A Well-Known Central Station

Two large surface condensers under construction at Honesdale plant. Right: conventional, external type atmospheric relief valve. Left: Lummus built-in type of atmospheric relief valve — saves space, provides additional support.

Among several large surface condensers under construction at the Honesdale plant of The Lummus Company is a 36,000 square feet condenser. Interesting features of Lummus design contributing to the efficiency of this condenser are:

Distinctive tube sheet layout, providing large internal steam space, permitting free longitudinal steam distribution.

Full deaeration within the condenser—all condensation being run over plates and exposed to live steam.

Entire design, including air coolers, contained within circular shell — no external steam domes or other parts to take up unnecessary space.

Write for data on Lummus Surface Condensers, Steam Jet Air Pumps, Extraction Heaters and other heat exchange equipment.

THE LUMMUS COMPANY · 420 LEXINGTON AVE., NEW YORK, N.Y.

LUMMUS

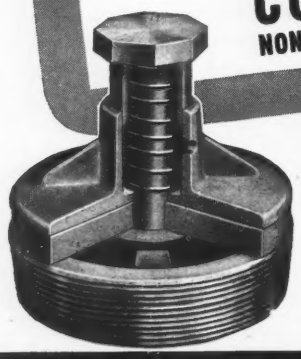
WANT To GET MORE WORK OUT Of YOUR STEAM PUMPS?

The tilting action of some reciprocating pump valves permits the seat to wear unevenly, means the pump has to operate faster and waste steam to carry its load.

COMBINATION Pump Valves help you get more work out of your pumps because these valves are built especially to prevent tilting and consequent slippage. Seat, stud and spring are made of long-lasting Phosphor Bronze.

Many users say steam and renewal savings of COMBINATION Pump Valves repay their cost in six months' time. They match the fine performance of COMBINATION Silent Check Valves. . . . . .

COMBINATION
NON-TILT, NON-SLIP VALVES



High Priority Needed: The use of critical materials in producing COMBINATION Pump Valves makes it necessary for buyers to furnish a high priority. Your cooperation in furnishing complete priority data with each order will aid us in expediting shipments and in better serving the nation's war effort.

COMBINATION PUMP VALVE CO.
846 WIOTA STREET, PHILADELPHIA, PA.

Win Today's Battle Against

with
ECLIPSE METAL HOSE

Its deep, parallel sidewall corrugations combine maximum flexibility with lasting toughness—makes Eclipse Seamless Metal Hose the logical low-cost material for Diesel exhausts and for handling all kinds of liquids or gases where vibration and expansion are present.

Eclipse Metal Hose withstands high pressure and temperatures. Monel hose is stocked in sizes ⅛ in. to 2 in. I.D.; steel hose can be produced up to 40 in. I.D. Write us about your problems of conveying non-solids, non-abrasives. Ask for descriptive bulletin.

For
LOW COST
LEAKPROOF
HANDLING OF
OILS
•
CHEMICALS
•
REFRIGERANTS
•
GASES
•
AIR
•
STEAM
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VACUUM
•
HYDRAULIC
•
Etc.

MANUFACTURED AND SOLD BY
BENDIX AVIATION CORPORATION
Dept. 19 - Phila. Div. PHILADELPHIA, PA.

T. M. Bohen, president of Whitehead Metal Products Co., Inc., announces that Elmer W. Silver, secretary, was elected treasurer of the company, succeeding the late William L. Rianhard. Mr. Silver will continue as secretary, to which office he was elected last March. Previous to that time he had been assistant secretary for 10 yr. He is a member of the management committee and has been with the company for over 26 yr.

W. H. and L. D. Betz, Philadelphia, Pa., announce the transfer of Edward C. Feddern from their general laboratories to the department of research.

Mr. Feddern, a graduate of Drexel Institute of Technology, has served as a water chemist with the Betz Laboratories for the past 8 yr. Mr. Feddern will devote the major portion of his time to the study of scale prevention and sludge fluidity in connection with cooling waters.

Cochrane Corp., Philadelphia, Pa., announces the appointment of the Energy Control Co. as flow meter representative for eastern Pennsylvania, southern New Jersey, Delaware and Maryland. Energy Control Co. is located at 3107 No. Broad Street, Philadelphia, and will handle Hays combustion control and instruments and the Heacon damper, and will also represent these lines in New York City and vicinity, including western Connecticut and northern New Jersey. The company is headed by J. T. Vollbrecht who will be assisted by C. L. Myers. William Ruglass is in charge of the Philadelphia office staff, with the service division headed by Ralph Kimball.

The McClave Co., Allentown, Pa., announced recent appointments of sales representatives; Warner E. Spencer, 220 Delaware Ave., Buffalo, N. Y., manager of sales for western New York State and northwestern Pennsylvania. M. C. Merrihew, 37 Burnham St., Belmont, Mass., manager of sales for Maine, New Hampshire and eastern Massachusetts. E. C. Sholler, 1600 Arch St., Philadelphia, Pa., manager of sales for Delaware and Maryland.

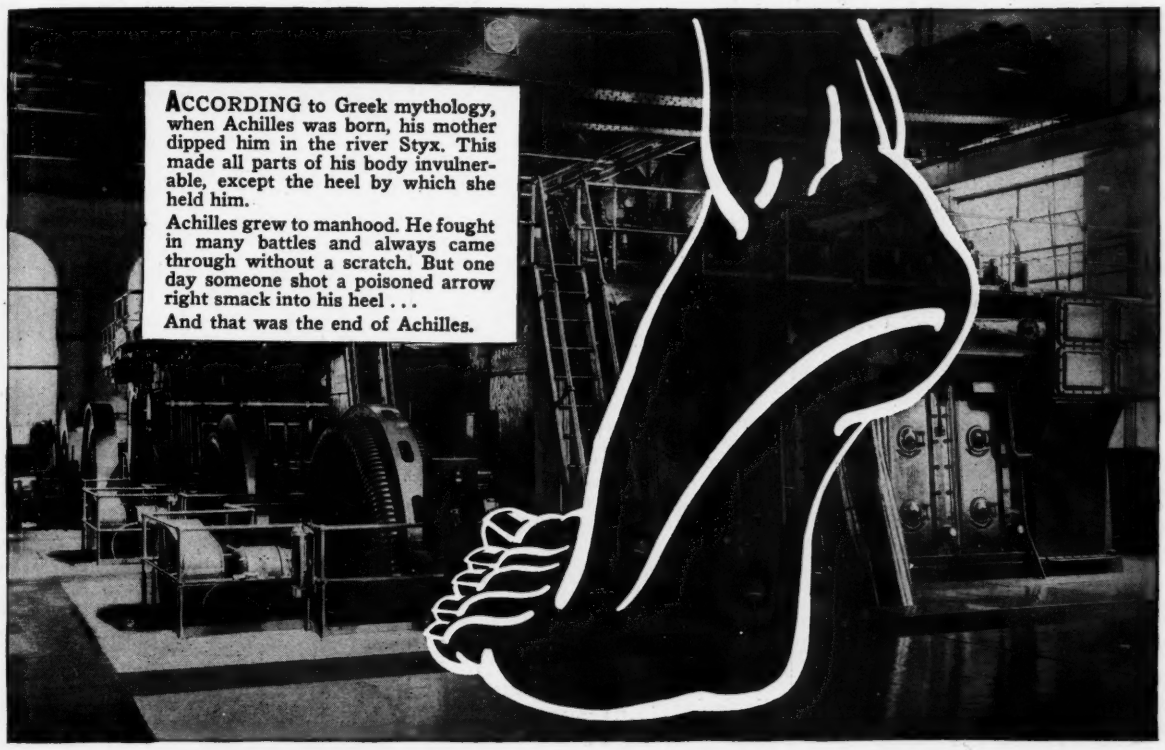
C. A. Warg, formerly chief mechanical engineer of The McClave Co., has resumed his duties as head of the company's engineering department.

Recent Elliott Appointments

L. A. Kunzler

L. A. KUNZLER, who has been with Elliott Co. since 1935 and has been located in the Tulsa office for the past 4 yr., has been made field manager of the tube cleaner department at Springfield. After spending some time at headquarters on development plans for tube cleaners and cutting heads, Mr. Kunzler will devote the greater part of his time to traveling around the country in the interest of tube cleaner applications in both refineries and industrial power plants.

Remember the story of Achilles' Heel?


ACCORDING to Greek mythology, when Achilles was born, his mother dipped him in the river Styx. This made all parts of his body invulnerable, except the heel by which she held him.
Achilles grew to manhood. He fought in many battles and always came through without a scratch. But one day someone shot a poisoned arrow right smack into his heel . . .
And that was the end of Achilles.

There's a moral in it for every Diesel Engine Owner!

Your Diesel engine has its own Achilles' heel.

It's the need for proper lubrication.

Without proper lubrication your Diesel is vulnerable. A burnt-out bearing may hold up production indefinitely. That means precious man-hours lost, schedules delayed, and a costly repair bill for you to pay.

These days, with quotas going up . . . with engines driving longer and harder than ever . . . and with Diesel parts almost impossible to replace — you cannot afford to take chances with makeshift lubrication. *Continuous, efficient operation demands a lubrication plan designed for your particular job!*

That's where a Cities Service lubrication engineer can be of great help to you. He knows what you're up against, and he has the necessary "know-how" and special instruments to tackle the job scientifically.

There's no charge for this friendly consultation. Simply phone or write the office nearest you.

An informative booklet, "Diesel Engine Lubrication," is yours for the asking. Just check the space indicated.

OIL IS AMMUNITION—USE IT WISELY!

CITIES SERVICE OILS
ONCE-ALWAYS

Write to —
CITIES SERVICE OIL COMPANY
Room 1326, Sixty Wall Tower, N. Y.
or any of the following offices:
CHICAGO . CLEVELAND . ST. PAUL
KANSAS CITY . BOSTON . TORONTO
or to
ARKANSAS FUEL OIL COMPANY
SHREVEPORT . ATLANTA . BIRMINGHAM

Please send me your booklet, "Diesel Engine Lubrication." ☐ P. P.

Name_____

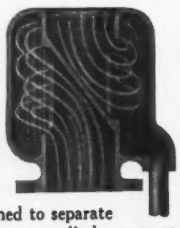
Firm Name_____

Address_____

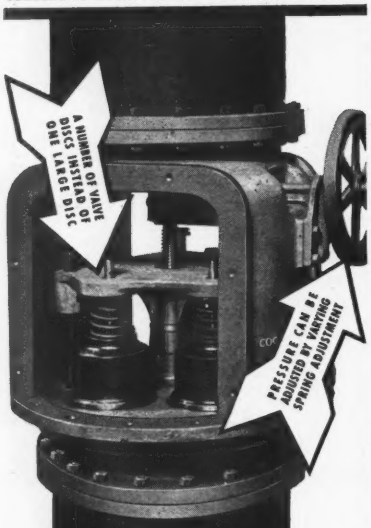
City_____ State_____

A LUBRICANT FOR EVERY INDUSTRIAL NEED

COCHRANE
Exhaust Head



Incorporates a highly efficient free-flowing baffle type construction and large port area to minimize back pressure. The Cochrane Exhaust Head is designed to separate condensate and oil from steam discharge to atmosphere and prevent raining of water and oily condensate on the roof. Ask for Publication 2960.



The Multiport principle of using a number of small discs instead of one large one eliminates sticking, freezing and jamming common in single disc valves used to control atmospheric relief, back pressure, etc.

Cochrane Multiport Valves have been giving successful service for many years in more than 12,000 plants. Ask for Publication 2870.

COCHRANE CORPORATION
3106 N. 17th St., Phila., Pa.

Cochrane

MULTIPORT RELIEF VALVE

Neil A. Benson has been appointed works manager of the Jeannette plant. Mr. Benson has been connected with the General Electric Co., Remington Arms Co., Ilion, N. Y., and for the past 8 yr. has been superintendent and manager of the metal fabricating plant of Talon, Inc., Meadville, Pa.

H. Lee Sterry has been appointed director of a new department of commercial research. His background in sales, engineering and market research has been gained with such companies as Warner & Swasey, Bullard Co. and Barrington & Associates. J. P. Stewart who has been with the Elliott Company for 14 yr. and for the past year has been manager of the supercharger sales department, has been appointed as Mr. Sterry's assistant director.

The new manager of the supercharger sales department is C. F. Harms. He has been with the company some 20 yr. since graduation from the University of Illinois. He has been a field engineer in the Chicago and Minneapolis offices and joined the supercharger sales department last September.

John W. Ryon has been appointed general plant engineer of the company's three plants. He will act as staff advisor to the general management and as plant engineer for the Jeannette works.

Fred T. Whiting Honored

FRED T. WHITING, manager of the Westinghouse Elec. & Mfg. Co. Northwestern District, was recently awarded his company's highest honor —the Westinghouse Order of Merit for distinguished service. Since its inception in 1935, the Westinghouse Order of Merit has been presented to some 250 employes for outstanding contributions to the electrical and mechanical arts and to their company's progress.

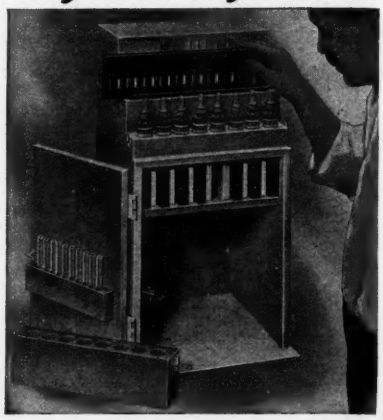
Born at Knoxville, Iowa, in 1890, Mr. Whiting attended grade and high school at Waukee, Iowa, and graduated from Iowa State College in 1913. The same year he joined the student apprentice course at the Westinghouse Machine Co., Pittsburgh, Pa., which in 1915 merged with the Westinghouse Elec. & Mfg. Co. Two years later Mr. Whiting was assigned to the Chicago office, and during the first World War he achieved the rank of major.

In May, 1919, Mr. Whiting became a salesman in the Westinghouse Chicago office and later was successively manager of the engineering and the industrial divisions of the Chicago office. In 1930 he was appointed manager of the Northwestern District.

R. G. Hanson and R. E. Powers Promoted

RAY G. HANSON has been appointed manager of the Westinghouse Manufacturing and Repair Department at Denver, Colo., and R. E. Powers, formerly of Chicago and New York, has been named Pacific Coast District manager of the Manufacturing and Repair Department, as announced by H. F. Boe, manager of the District Manufacturing and Repair Division. Mr. Hanson comes to Denver from Milwaukee, Wis., where he managed the Manufacturing and Repair Department for 4 yr. Born in

Now...
MAKE pH DETERMINATIONS
anytime.. anywhere!

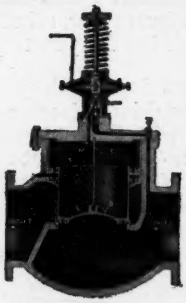


The Taylor Dalite pH Slide Comparator permits speedy, dependable boiler water control. Dalite glass gives uniform lighting day or night. Comparator base, 3 to 8 color standard slides for pH, phosphate, etc., vials of indicator solutions, pipettes and test tubes . . . all fit into 12" x 12" x 21" wooden case. All Taylor Color Standards carry AN UNLIMITED GUARANTEE AGAINST FADING.

See your dealer or write direct.

W. A. TAYLOR AND CO.
7301 YORK RD. • BALTIMORE, MD.

See page 40 of our new 96-page catalog for information on this
SINGLE ACTING STANDARD ALTITUDE VALVE



Where a separate discharge line or bypass arrangement is used for removing storage water, this valve, placed in the upstream pressure line, will maintain a uniform water level in tank, standpipe or reservoir within a range of 3" to 12" variation.

GOLDEN-ANDERSON VALVE SPECIALTY CO.
Fulton Building Pittsburgh, Pa.

Bartlett-Snow

CENTRAL STATION EQUIPMENT

—including rail, boat and truck receiving facilities, large capacity belt conveyors, feeders, bunkers, crushers, distributors, coal storage and reclaiming systems, meets every central station requirement. Eng. Bul. No. 83, describing recent installations and giving construction details of typical equipment units, sent on request. The C. O. Bartlett & Snow Co., 6258 Harvard Ave., Cleveland, Ohio.

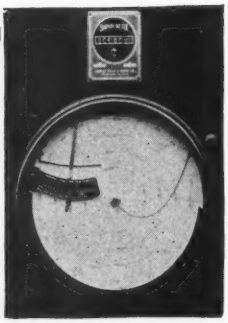
HERE'S THE

FLOW RATE CHART

THAT'S REALLY

EASY TO READ

GET THE WHOLE STORY AT A GLANCE!



Why worry with factors and "micro-scopic" low rate readings when all Simplex MS meters use an evenly spaced chart—with even graduations from 0 to maximum.

WHAT DOES THIS MEAN TO YOU?

1—The direct reading chart with 0 factor only assures the same high accuracy and ease of reading anywhere in the flow range from minimum to maximum flow.

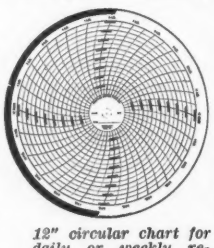
2—Even graduations make it easy to read low as well as high flows from a distance.

3—Greater accuracy of chart readings from planimeter.

4—Extreme accuracy of chart record is inevitable since pen arm connects directly with bell-shaped float.

5—Special moisture proof paper eliminates stretching and shrinkage—chart cannot slip in use.

Simplex has "engineered" the chart on the MS meter as well as every mechanical detail. This direct reading chart is made possible because of the unique bell-shaped float which extracts the square root of the law of flow. Here is accuracy, ease of recording, and ease of reading — yours for the using in every Simplex Type MS meter. There is no finer meter at the price. Specify Simplex MS meters. Write for details today.



12" circular chart for daily or weekly removal. Electric or mechanical clock drive.

SIMPLEX VALVE & METER CO.

6783 UPLAND STREET, PHILADELPHIA, PA.

SIMPLEX METERS

THE METER WITH THE BELL SHAPED FLOAT

Minneapolis, Minn., in 1901, he studied electrical engineering at Dunwoody Industrial Institute in that city and graduated in 1917. During the last war, he acted as instructor at Dunwoody Institute, teaching Army and Navy men elementary electricity and the technicalities of direct current electric machinery.

After spending one year as a traveling electrician for the Chicago-Omaha Railway, Mr. Hanson joined Westinghouse in 1919 as a member of the electrical test staff in East Pittsburgh. He was transferred to the Northwestern District Service Department in Chicago in 1922 and served in engineering, sales and executive positions in Chicago, Minneapolis, Peoria, and Milwaukee during the following 20-yr. period.

Mr. Powers was manager of the Manufacturing and Repair Department of the Westinghouse Northwestern District for the past 4 yr. On the Coast he will have charge of all activities of his department in a territory comprising all or parts of 11 western states, Alaska and the Hawaiian Islands. Included are the District headquarters plant in Emeryville and service plants in Seattle, Wash.; Portland, Ore.; Los Angeles, Calif.; and Salt Lake City, Utah.

A native of Davenport, Wash., Mr. Powers received an electrical engineering degree from Washington State College at Pullman, Wash., in 1923 and joined the Westinghouse Graduate Student Course at East Pittsburgh. He served in various capacities at East Pittsburgh and New York until 1936 when he was made manager of the Engineering Division, Eastern Division, at New York. He held that post until his transfer to Chicago in 1938.

Recent Changes in Public Service Corporation

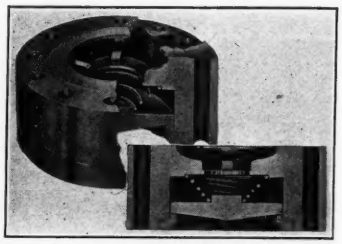
THE BOARDS of directors of the operating companies of Public Service Corp. of New Jersey, announced recent changes in its organization. Vice-president Robert A. Zachary to be vice-president in charge of public relations. The office of director of publicity to be disassociated from the office of vice-president in charge of public relations. Walter Fox Allen will be in charge of the publicity and advertising department and continuing as director of publicity. These changes were occasioned by the retirement of John L. O'Toole as vice-president in charge of public relations. Russell H. Williams was appointed executive assistant, Essex Division and will report to the vice-president in charge of public relations and be a member of the public relations committee. Charles C. Harbinson will remain as assistant in the office of the vice-president in charge of public relations.

Haering Company Expansion

SEVERAL thousand additional feet of floor space has been added to the D. W. Haering Co. general offices on the 18th floor of the Engineering Building in Chicago. Recent personnel additions to the Haering organization include the appointment of Arthur J. Grotsma, controller, and Robert Seyl, director of service. Ilya Stephanoff, Mitchell Stanislaus Sniegowski, and Isabelle Luan, chemists, have also been added to the Laboratory Staff.

WILLIAMS-HAGER

Flanged Silent Check Valve



- Non-Wear Conical Spring
- Renewable Disc and Seat
- Works In Any Position
- Noiseless In Operation
- Protection Against Water Hammer

These improved side-guided check valves stay tight under every condition of service and pressure. Easily installed between flanges and readily removed for inspection. Sizes up to 20 in. and for pressures to 6,000 lb. They will handle all liquids, hot or cold—water, oil, gasoline, chemicals, etc. Get further details about this economical protection for pumps and service lines. Ask for Catalog No. 142.

THE WILLIAMS GAUGE CO.

1620 Pennsylvania Ave., Pittsburgh, Pa.

To handle 175 g.p.m. of 200 to 500 SSU lube oil against 50 lb. gage from 15 in. Hg. suction at 1750 r.p.m.

New Style

PUMPS

for the New Ships

On many of the ships recently built and now under construction, the methods of handling fuel and lubricating oil have been vastly improved by adoption of the

De Laval-IMO Oil Pump

Its exceptional compactness and its ability to operate directly connected at motor and turbine speeds save space and weight, and greatly simplify the power plant layout. There are only three moving parts; no valves, no gears, no separate bearings, no reciprocating parts. The pump interior is readily accessible.

Ask for Catalog 1-96.

IMO PUMP DIVISION

of the

De Laval Steam Turbine Company

Trenton, New Jersey

HOW TO GET MORE SERVICE FROM PUMP RODS AND SHAFTS...

PART 1—

Re-conditioning by machining and re-finishing

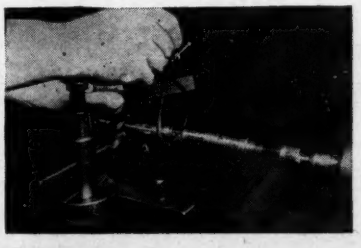
Worn pump rods, shafts and wearing sleeves are readily renewed by machining and refinishing, as described below. Usually, a light cut of less than 3/64 in. is sufficient to clean up the worn section.

However, one precaution must be observed: If too much metal must be removed the shaft may be unduly weakened. Therefore, if a shaft shows evidence of "whip" or a reciprocating pump rod tends to "bow" on pressure stroke, the pump manufacturer should be consulted. He will advise whether shaft needs building up before machining.

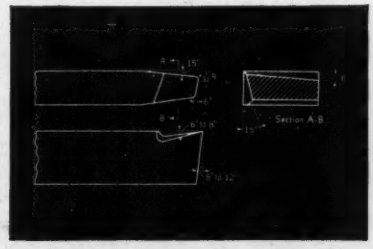
Methods for accomplishing the latter will be outlined in Part II of this subject.

Shafts and rods of Monel or "K" Monel can be reconditioned as described. Their high mechanical properties provide an extra margin of strength, rigidity, and toughness above the normal requirements of actual service.

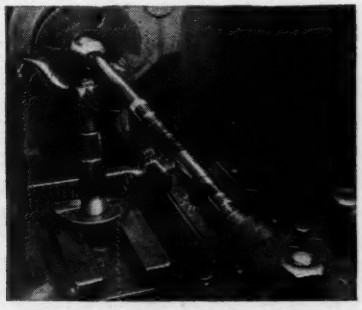
THE INTERNATIONAL NICKEL COMPANY, INC.
67 WALL STREET NEW YORK, N. Y.



1. Set up shaft or rod rigidly between centers of engine lathe. Support with a steady-rest, if necessary, to prevent chatter. Measure diameter of worn section with calipers or a point micrometer to determine amount of metal to be removed.



2. No special cutting tool needed — high speed tool preferable, but plain carbon steel satisfactory for this limited amount of machining. In machining Monel or "K" Monel tool should be ground as in sketch. Either a forged lathe tool, or a commercial tool bit (⅜-inch or ¼-inch) may be used.



3. Take rough and finishing cut leaving enough metal for filing and lapping to final size. No lubricant needed, machining should be done dry. When refinishing rods, length of taper on steam end can be reduced to suit refinishing dimension, but original length of taper on the liquid end should be retained to support bronze pistons. For machining Monel, a speed of 55-60 ft. per min. with .005 in. feed can be used; for "K" Monel, a speed of 35 ft. per min. with .005 in. feed.

4. File machined surface with light pressure, using single cut, smooth file. File should be kept clean, "balled filings" avoided by chalking. A shaft or rod should be filed in direction in which it operates. A shaft should be filed as it revolves in the lathe; a reciprocating rod should be draw-filed lengthwise, turning shaft by hand as filing progresses.

5. Lap filed surface with No. 0 then No. 00 emery cloth. Shaft or rod should be lapped in the direction it operates. The cloth may be held with *half-round* wooden block. Only use emery cloth as long as a clean metal surface results. Cloth should not burnish.

6. *Before re-installing*

(*a*) Carefully clean finished surface to remove any particles of emery.

(*b*) Check need for new glands, bushings or followers, and larger size packing to fit smaller diameter of re-conditioned rod or shaft.

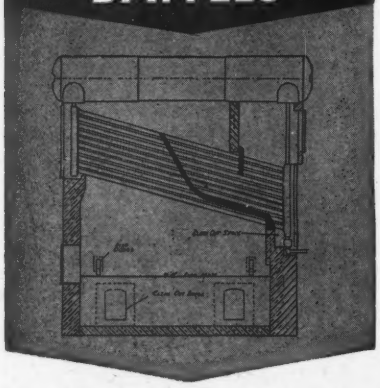
(*c*) Correct faulty condition or improper operation which may have caused original wear.

★ ★ ★ ★ ★ INCO NICKEL ALLOYS ★ ★ ★ ★ ★

MONEL • "K" MONEL • "S" MONEL • "R" MONEL • "KR" MONEL • INCONEL • "Z" NICKEL • NICKEL

Sheet... Strip... Rod... Tubing... Wire... Castings

ANY type of boiler will deliver MORE POWER at LESS COST with Enco Streamlined BAFFLES

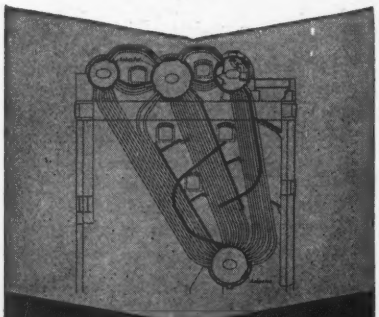


THE cross-flow principle of Enco Streamlined Baffles with its higher efficiencies, may be applied to any type of boiler—horizontal or vertical, straight or bent tube.

By streamlining and curving, gas passages are tapered to maintain velocity as the gas volume is reduced, resulting in a higher rate of heat transfer to boiler and superheater surfaces, and lower flue gas temperatures.

Enco Streamlined Baffles reduce draft loss by eliminating eddy currents, bottlenecks and dead gas pockets—save steam because soot blowers work less often and more effectively.

Ask for Bulletin BW-40 containing valuable engineering data on modern baffle wall construction—It's free.



THE ENGINEER CO.
Enco 75 West St. New York, N. Y.

Jack Daggett, chemist, has been transferred from the laboratory to the field engineering department and John J. Meacher, field engineer in Cincinnati has been promoted to District Manager of the new Cincinnati District Offices.

D. W. Harrington has been placed in charge of the Philadelphia Offices at 1200 Commercial Trust Building with A. J. Levington and John C. McKeon operating under his direction. Dr. Leonard Elion has been added to the New York field staff and William Wagner has been placed in field service in Boston, Mass.

John Banks has been placed in charge of the Pittsburgh office at Suite 207 Investment Bldg., 239-4th Ave., and Brad Fogarty has been placed in the Central Pennsylvania field operating from 211 E. First St., Bloomsburg, Pa. Guy Hudson has been placed in the Arkansas River Valley and Texas Panhandle areas operating from Wylie, Colo.

John P. Warble has been added to the Chicago field staff and Lewis C. Hills has been placed in the Indianapolis Territory. J. C. Dickinson has been assigned to field work in Jacksonville, Florida, and John D. Noyes has been assigned to field engineering in the Miami, Florida, area.

New Director of National Safety Council

NED H. DEARBORN, New York, has been named executive vice-president and managing director of the National Safety Council. He succeeds W. H. Cameron who is retiring after nearly 30 yr. as managing director.

Mr. Dearborn comes to the Council from New York University, where he has been dean of general education for the past 8 yr. He has had wide administrative experience, and has been actively engaged in accident prevention for several years. He was responsible for the development 4 yr. ago of the Center for Safety Education at New York University. He has been vice-president for education of the National Safety Council for 2 yr. and for the last year has been chairman of the Council's special finance support committee.

Before becoming managing director of the Council when it was organized in 1913, Mr. Cameron was manager of the casualty and safety departments of the American Steel Foundries in Chicago.

G. P. Longabaugh Joins Subcontracting Staff

NOW SUBCONTRACTING war work at the rate of more than $100,000,000 a year to expedite production, the Westinghouse Elec. & Mfg. Co. announced the appointment of G. P. Longabaugh to coordinate and direct manufacturing engineering activities of this vast "share the work" program. Mr. Longabaugh will be able to assist the hundreds of outside manufacturers who receive subcontracts, giving these manufacturers the advantages of Westinghouse "know-how".

The total of Westinghouse subcontracts placed this year already has exceeded $50,000,000. The 1941 total was $18,777,605. More than 1000 subcontractors in 29 states now are helping Westinghouse produce record quantities of electrical equipment for the nation's armed forces and war production plants.

Consult us for:

Radial Brick Chimneys
Common Brick Chimneys
Ornamental Chimneys
Linings for Steel Stacks
Chimney Repairs and Extensions
Installing, Repairing Lightning Rods

AMERICAN CHIMNEY CORPORATION
147 Fourth Ave., New York City

BRANCHES: BOSTON, MASS.
PHILADELPHIA, PA. • PITTSBURGH, PA.
CLEVELAND, O. • DETROIT, MICH.

HENSZEY
BOILER FEED
REGULATORS

GOES IN FEED LINE

The Henszey Boiler Feed Regulator controls boiler water levels continuously and accurately under *all* load conditions!

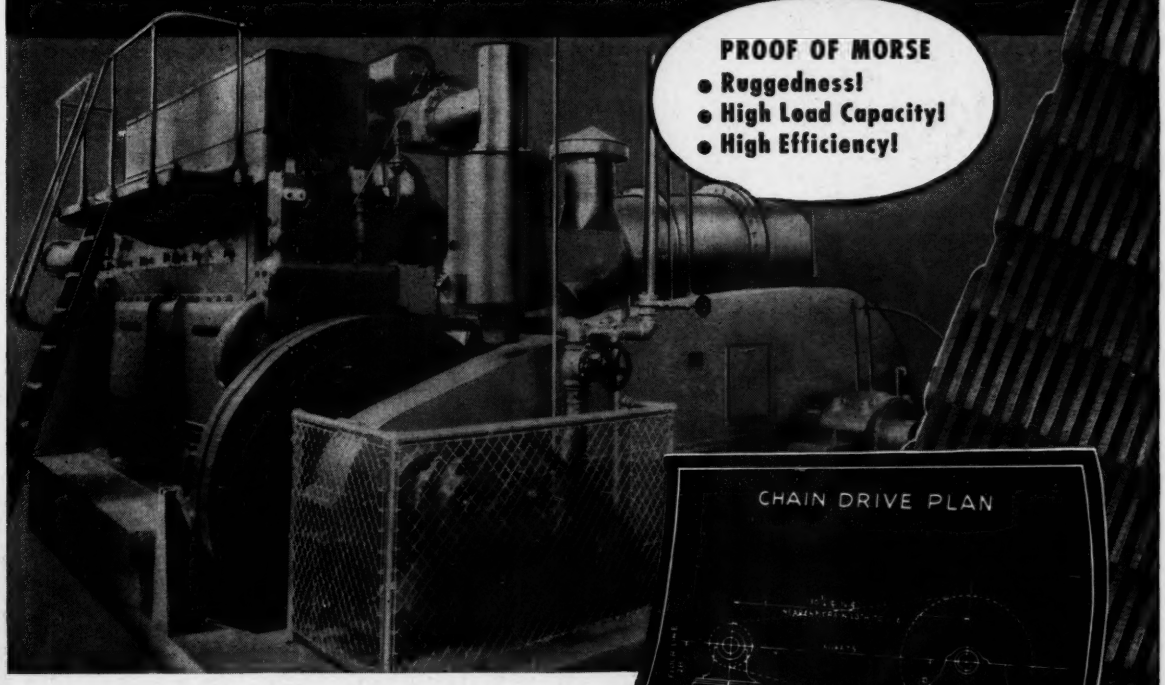
These simple, compact, self-contained units go right in the feed line and require no additional structural support. They are as easy to install as a simple gate or globe valve. Once installed and set for operation no further attention is necessary—nothing to get out of order—nothing to reset.

Send for latest Bulletin containing full details.

HENSZEY COMPANY
Dept. C9—Watertown, Wis.

TEXAS too, keeps the Pressure Up

500 H.P. Water Pump driven with MORSE SILENT CHAIN DRIVE...



PROOF OF MORSE
- **Ruggedness!**
- **High Load Capacity!**
- **High Efficiency!**

IN WESLACO, TEXAS, power for maintaining water irrigation supply throughout two counties is efficiently transmitted from a 540 H.P. gas engine operating at 360 RPM to a low head pump at 120 RPM by means of a Morse silent chain drive. The long history of such installations shows the ruggedness, dependability, and smooth quiet action of Morse drives.

Extremely compact, Morse Chain Drives are low in first cost, require practically no maintenance, and operate at 99.4% efficiency.

Whether your drive requirements be conventional or unusual, there is a Morse Silent or Roller Chain Drive in single and multiple widths to fulfill your exact demands. Sizes from fractional to 5000 horsepower. Morse Representatives everywhere are ready to help increase your productive output—engineer chain drives to the job.

SILENT CHAINS ROLLER CHAINS FLEXIBLE COUPLINGS CLUTCHES

MORSE *positive* DRIVES

MORSE CHAIN COMPANY ITHACA N. Y. DIVISION BORG WARNER CORP

Coal Storage now War Business

All government departments urge ample coal storage NOW—to relieve transportation, reduce manpower in mines, prevent interruption of industrial production.

COAL STORAGE IS A GIFFORD-WOOD SPECIALTY

Such important problems as segregation, breakage, slacking, spontaneous combustion and related considerations are old stories to GIFFORD-WOOD. Most of the outstanding retail coal storage plants in the East are Gifford-Wood designed and produced. So, also, are many important industrial coal storage as well as coal and ash handling plants.

If you have a coal storage plan under consideration, save time, work and money by calling in a G-W engineer.

GIFFORD-WOOD CO.
Founded 1814
HUDSON, N. Y.
NEW YORK 420 Lexington Ave.
CHICAGO 565 W. Washington St.

2694

Born in McKeesport, Pa., in 1900, Mr. Longabaugh is a graduate of the Westinghouse apprentice training course and studied at Carnegie Tech night school. He first joined the company as an apprentice tool maker and machinist in 1917 and completed the course in 1922. After working as a tool maker, he became an instructor in the apprentice school and then foreman of the training course.

G. W. Spaulding and D. Gunn Promoted

PENNSYLVANIA WATER & POWER CO. announced recently that G. W. Spaulding, formerly assistant chief engineer, has been promoted to superintendent of power, and Donald Gunn, formerly assistant to chief engineer to chief engineer.

Mr. Spaulding came to the company in 1924 as test engineer, was later assistant chief of tests, assistant to general superintendent in charge of power studies and system planning, and assistant chief engineer, coordinating engineering studies and construction activities, and is a graduate of the Massachusetts Institute of Technology in electrical engineering.

Mr. Gunn, who is a graduate of the Georgia School of Technology, came from the Duquesne Light Co. in 1930 and for the past 3 yr. has been assistant to chief engineer, responsible for installation of power plant equipment and supervision of contract work for the erection and installation of machinery.

General Electric Appoints M. B. Elliot

THE APPOINTMENT of M. B. Elliot to manager of sales, Unit Equipment Section, has been announced by R. C. Sogge of General Electric's Central Station Department. Mr. Elliot will handle sales of unit substations and other similar factory-assembled equipments.

Born in Covington, Ky., Mr. Elliot was graduated from Virginia Polytechnic Institute in 1920, with a B.S. in electrical engineering. In 1920, he joined the General Electric as a test engineer. He was transferred in 1924 to the Regulator and Capacitor Section of the Central Station Department, and in 1926 was sent to Cleveland, Ohio, as transformer specialist for the East Central District.

MANUFACTURERS' NEWS

The Ohio Injector Co., Wadsworth, Ohio, manufacturers of bronze, iron and steel valves, has recently received the Army-Navy "E" for excellence pennant, according to an announcement of James Forrestal, Under-Secretary of the Navy.

Formal presentation ceremonies were held at the Wadsworth plant with Army and Navy officials making the award. A lapel insignia to all O.I.C. employes was also awarded.

The S. F. Bowser Co., Ft. Wayne, Ind., and their subsidiary, Fostoria Screw Co., Fostoria, O., have recently been awarded the joint Army-Navy "E" production pennant.

Help Wanted

Large, southern New England industrial company operating own power plant is seeking night power plant supervisor.

Must be United States citizen, preferably between 35 and 40 years of age, with suitable experience in public utility, or large industrial plant, on turbo generators, steam and air units. Write Box 1408, POWER PLANT ENGINEERING, 53 W. Jackson Blvd., Chicago, Ill.

Opportunities Offered

MONEY AVAILABLE for NEW enterprise

An executive whose business has been curtailed by the war seeks a new use for his capital. He would be interested in the commercial development of a new product or invention, or a business that needs new capital, with or without his own personal services. Confidential correspondence invited.

Box 1409
POWER PLANT ENGINEERING
53 West Jackson Blvd., Chicago, Ill.

CLASSIFIED

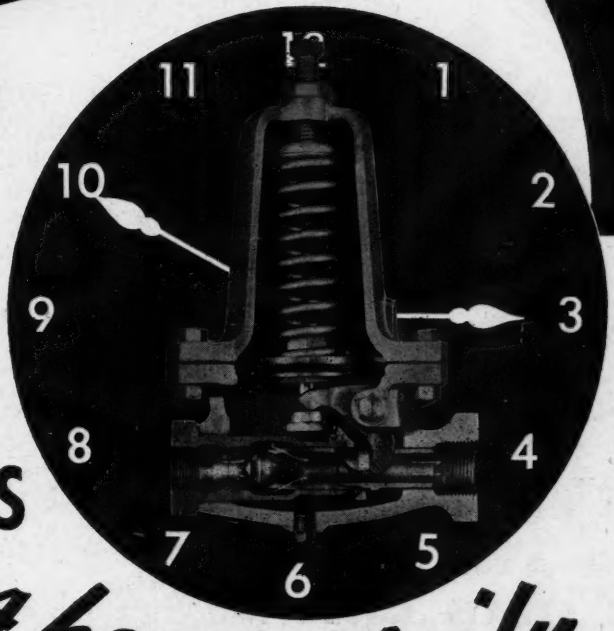
For Your Convenience

Everything from Air Compressors to Whistles—266 different classes of products used in operating and maintaining power plants—are listed each month in the Where-To-Buy section of this magazine.

Make it a rule to turn first to this up-to-date directory when you're in the market for power service equipment and supplies. It's classified for your convenience, can save you time and money.

IN THESE DAYS OF 24-Hour Operation

Get THESE DOZEN VALVE BENEFITS



24 hours daily

1. MAXIMUM CAPACITY WHEN NEEDED MOST
2. ACCURATE PRESSURE CONTROL UNDER TOUGHEST WORKING CONDITIONS
3. TROUBLE-FREE SERVICE
4. SMOOTH OPERATION
5. TIGHT CLOSURE
6. ACCURATE REGULATION
7. SPEEDIER PRODUCTION RESULTS
8. ELIMINATION OF FAILURES
9. CONSTANT DELIVERY PRESSURE
10. COST SAVING OPERATION
11. NO SPOILAGE
12. PRACTICALLY ZERO IN MAINTENANCE COSTS

You can find out full details on all of these 12 points by reading Bulletin "1000"—send for it.

CASH STANDARD *Streamlined* TYPE 1000 PRESSURE REDUCING VALVE

Whether you are operating one, two, or three shifts a day, the "1000" valve, through "Streamlined" performance, is a valuable factor in aiding in smooth operation, high production, and better quality results. Check the twelve points and you will see that you get every advantage in pressure reduction for steam, air, oil—most anything that flows. The "1000" valve stays on the job for years rendering remarkable service—all without giving trouble. The Streamlined flow around the inner valve eliminates turbulence, thereby giving you best control under varying loads. You get better pressure control and greater capacity because there's a straight path for the fluid through the flow tube.

HERE'S THE "1000" FLOW PATTERN
The Streamlined form of the inner valve eliminates turbulence. It produces the flow pattern shown at left which makes for maximum capacity when it is needed most and permits accurate pressure control under toughest working conditions.

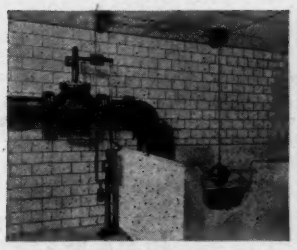
A. W. CASH COMPANY
DECATUR, ILLINOIS

CASH STANDARD CONTROLS.. VALVES

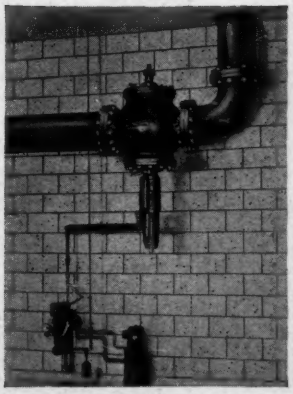
A CASH STANDARD "GET ACQUAINTED" COLUMN

Question: **"Don't you people make anything besides that Streamlined Valve you talk about so much?"**

Answer: **"Yes Sir; we do! And we propose to picture one or two of them here each time."**



In automatic liquid level control, two things are often of prime importance: (1) to hold the level within the closest kind of limits; (2) to do it dependably, day by day. How Cash Standard controls do both is shown above. A Type 100-L Controller operates a 12" Balanced Valve regulating liquid supply to a large tank. It is pilot actuated for sensitivity. It has operating power to spare—for any size Valve, however large.



Here, a Type 100-L Controller operates a 10" Cash Standard Balanced Valve. It regulates flow through a make-up line to a "dirty water" heater on the floor above. The lever of the "100-L" responds to slightest movement of a float in the heater—causing immediate movement of the power piston which operates the Valve. But there is no "hunting" because the Controller is fully compensated. It has a "range" adjustment too. It gets accurate results with any size valve—no matter how small or how large the valve may be. It is simply a matter of using the right size power cylinder.

Get Free Bulletins on Above . . . Write to
A. W. CASH COMPANY
DECATUR, ILL.

METERS

HELP YOU ARRIVE AT ACCURATE STEAM COSTS

● Don't guess. Make accurate charges for steam against different departments, processes or buildings. Find out when and where your peak loads occur. Detect steam losses. Install ADSCO Rotary Condensation Meters.

METER COUNTER

Records in pounds of condensate on a Non-Fogging Dial.

Quickly installed — easily maintained! Factory-tested for accuracy within 1%! These efficient LOW PRICED meters are the standard in leading industrial plants, colleges and institutions.

●

Seven sizes, 250-12,000 lbs. per hour capacity.

Write for quotation, advising us the maximum pounds of condensate per hour or the equivalent direct radiation in the building or department. Also ask for Bulletin 35-80E.

AMERICAN DISTRICT STEAM COMPANY North Tonawanda N. Y.

Making "UP-TO-DATE" Steam Line Equipment for over 60 Years

ADSCO ROTARY
CONDENSATION METER
Combines High Accuracy With Low Cost

The Securities and Exchange Commission has entered an order approving the sale of the Greeley Gas and Fuel Co., Greeley, Colo., to a group of Chicagoans.

The property is a subsidiary of the National Gas and Electric Co. and the new purchasers include Keith Kindred and James S. Barcus, Chicago, and James C. Tucker, Austin, Tex., dealers in municipal bonds under the name of Barcus, Kindred & Co.

The International Diesel Electric Co., Inc., has leased the property at 11-49 44th Rd., Long Island City, for manufacturing and assembling machinery, machine parts and equipment.

The property consists of a large factory building, a 2-story brick office and drafting building and a single-story factory building suitable for small manufacturing.

Water Treatment Co. of America, Pittsburgh, Pa., developers of the Technical Water Conditioning System for boilers and industrial power equipment, announce the appointment of The Mutual Manufacturing & Supply Co., Cincinnati, O., as exclusive sales and service representatives in that area.

The Technical System, which is a method of balancing and controlling boiler feed waters with organic treatment, will also be handled through Mutual's Covington, Kentucky and Norwood, Ohio, branches.

In effecting the merger of the Airmax Corp., with the Pacific Gas Radiator Co. under the new name of Pacific-Airmax Corp. facilities of both companies will be extended in the war effort. The executive, technical and operating personnel have been merged at Huntington Park, Cal.

Officers and department heads of the newly merged corporation include Helen Hartfield, president; R. C. Gross, vice-president and general manager; L. M. Hull sales manager; A. A. Arnhym, chief engineer; E. M. Rahm, works manager; J. B. Marchand, purchasing agent.

New address of the Pittsburgh branch of the York Ice Machinery Corp. is the Hostetter Building, 7 Ferry St., Pittsburgh, Pa.

Announcement of three new South American sales outlets for products of Wheelco Instruments Co., Chicago, has been made by Richard A. Schoenfeld, vice-president and sales manager. Cia Argentina de Ingeneiria Idustrial, with headquarters at 375 Peru, Buenos Aires, will represent the company in Argentina; Miguel Khalife, with A. P. Green Chilena Ltda., at Casilla 13297 Santiago, in Chile, and Benech & Cia, at Cerrito 455, Montevideo, in Uruguay.

Buda Co., Harvey, Ill., has announced the opening of a new plant for building Diesel and gasoline engine generator units. The plant contains 65,000 sq. ft. of floor space and is to be known as the Diesellight division.

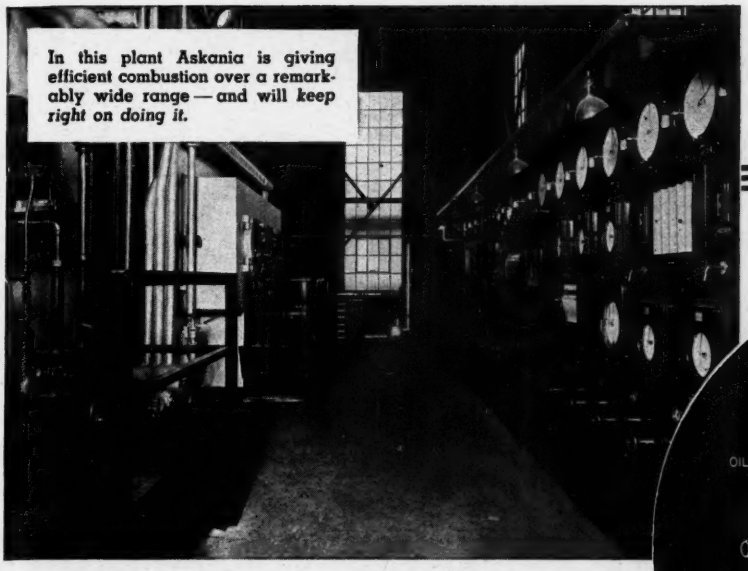
Walter Kidde & Co., 122 East 42nd St., New York N. Y., recently published Vol. 1, No. 1 of a new house organ entitled High Pressure. This will be a current review of recent developments in fire protection and in the handling of compressed gases, and is intended as a successor to the 15 yr. old paper called Lux-Rich Reports.

"Let's Better Our Best." This slogan was selected as the prize winner from 496 entries in a contest held by the LaPlant-Choate Mfg. Co., of Cedar Rapids, Iowa. The winner was Ben Schreckengast, a press brake operator. The contest was inaugurated as a reply to Mr. Nelson's plea for more production. Other slogans submitted in the contest were Crowd the Clock! More Bulldozers to Fight Bulldozing!, Plus Effort Today, Plus Security Tomorrow!, Increase Production to Stop Destruction! and Let's Produce Tomorrow's Today!

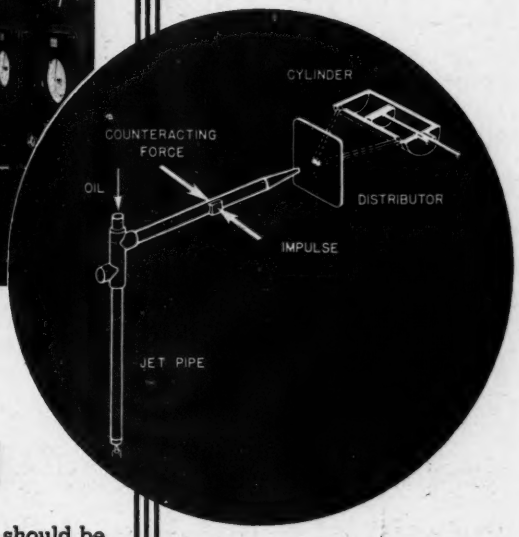
Diesel Engine Corporation Changes Name

THE ROGERS DIESEL AND AIRCRAFT CORP. recently became the new corporate name of The Cummins Diesel Engine Corp. of New York. President Ralph D. Rogers in making the announcement said that the new corporate name does not mean any reorganization or change of ownership.

The corporation operates two New York plants, one at 1120 Leggett Ave., and the other at 724 Garrison Ave., executive offices are located at the former address. The company was originally formed in 1934 as a distributing organization for the Cummins Diesel engine. In addition



In this plant Askania is giving efficient combustion over a remarkably wide range — and will *keep right on doing it.*



More than ever — you need this trouble-free control

IN the battle of production, the equipment in the front line should be judged as a soldier is judged—not by the way it starts, but by the way it *keeps going!*

Shut-downs for adjustments mean serious production loss now that boiler capacity is taxed to the limit. Tinkering with equipment that is supposed to be automatic diverts skilled men from jobs that are vital to defense. So today that distinguishing characteristic of Askania Combustion Control—its ability to do its job right day after day and year after year—means even more than ever before.

The recognized ability of Askania Systems to do a better job of controlling combustion—and do it without attention—is basic and inherent in the design of Askania equipment. Simple, precision-built equipment is *always* dependable equipment—and there is no better example of this than Askania Regulators.

The exclusive Askania Jet Pipe Principle not only means greater sensitivity of control; it also means greater *simplicity* of control. Naturally the same number of dollars buy more quality—more precision—in simple equipment than they could buy in complicated equipment. Since oil is used as the operating medium in Askania Regulators, all parts literally "run in oil" and every control-adjustment has the power and certainty of hydraulic operation.

You can put in an Askania System of Combustion Control—and forget it. Its precision-built memory will never forget to hold combustion efficiency at the peak.

ASKANIA REGULATOR CO., 1601 South Michigan Ave., Chicago, Ill.

The Exclusive ASKANIA JET PIPE PRINCIPLE

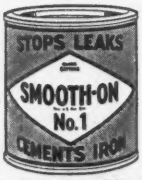
● Observe this principle carefully —for it is the secret of greater sensitivity of control with greater dependability and lower maintenance than can be achieved in any other way.

It consists of the jet pipe which swings on a hollow pivot into which oil is pumped. As the oil issues from the nozzle it strikes at two closely adjacent orifices in a distributor plate which are piped to each side of the double-acting piston which adjusts the valves, dampers, etc. The slightest variation in the "impulse" moves the jet pipe, causing the oil pressure to increase or reduce in either the right or left orifice, thus moving the piston to correct for the variation in the "impulse."

ASKANIA
REGULATOR CO. CHICAGO
AUTOMATIC CONTROL

Here's a Complete Repair Kit

for hundreds of war-time repairs



Sold in 7-oz., 1-lb., 5-lb. cans; 25-lb., 100-lb. kegs.

SMOOTH-ON No. 1
Quick-Hardening

SMOOTH-ON No. 2
Slow-Hardening

For repairing cracks in boilers, heaters, evaporators, condensers, pumps, and other castings; stopping leaks at pipe connections, bolts, rivets, seams, etc.; and tightening loose parts of apparatus and fixtures.

Sold in 1-lb., 5-lb. cans; 25-lb. kegs.

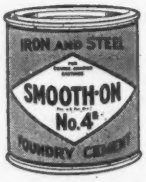
SMOOTH-ON No. 3
SMOOTH-ON No. 5

For making up tight screwed, flanged, hub or other types of pipe joints.

Sold in 1-lb., 5-lb. cans; 25-lb., 100-lb. kegs.

SMOOTH-ON No. 4

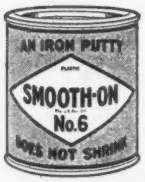
For truing up contours of castings and correcting surface blemishes. Selection of four grades to permit matching the color and grain of any iron or steel casting. Also foundry cements for brass, bronze and aluminum castings.



No. 4AA sold in 1-lb. cans; 10-lb., 50-lb. kegs. Nos. 4A and 4B sold in 1-lb., 5-lb. cans; 25-lb., 100-lb. kegs.

SMOOTH-ON No. 6

For making watertight joints at roof flashings, glass frames, foundation and window joints, filling in seams and rivet heads.



Sold in 1-lb., 5-lb. cans; 25-lb. kegs.

SMOOTH-ON No. 7

For waterproofing walls and interiors of tanks and cisterns from the inside; for making hard, dustproof and oilproof concrete floors; and for repairing ruts, holes and cracks in concrete floors.

Sold in 1-lb., 5-lb. cans; 25-lb., 100-lb. kegs.

Smooth-On compositions are obtainable from your dealer or, if necessary, from us. For your protection, insist on Smooth-On, used by engineers and mechanics since 1895.

FREE

40-Page Handbook explains how

This useful manual, illustrated with 170 diagrams, gives concise, simple suggestions that will save you time, labor and expense on repair and maintenance jobs all around the plant. A real necessity for every engineer, and will be sent you FREE if you fill in and return the coupon.

SMOOTH-ON MFG. CO., Dept. 31
570 Communipaw Ave., Jersey City, N. J.

Please send SMOOTH-ON HANDBOOK

Name .....

Address .....

9-42 .....

Do it with SMOOTH-ON

to its two New York plants, the Rogers corporation has plants in two other states. In 1940 it purchased the Edwards Co., Sanford, N. C., manufacturers of railway motor cars and aircraft equipment, and in 1941 through the Edwards Co. acquired control of the Hill Diesel Engine Co., Lansing, Mich. The two subsidiary companies retain their respective company names, but will be further identified as divisions of the Rogers Diesel and Aircraft Corp.

New Hays Representatives

THE HAYS CORP., Michigan City, Ind., recently announced the appointment of the Energy Control Co. as its representative in Philadelphia, succeeding the Paul B. Huyette Co., Inc. The Energy Control Co., J. T. Vollbrecht, president, has represented The Hays Corp. in the New York territory for the past several years. The Philadelphia territory comprises the eastern half of the state of Pennsylvania, all of Delaware and portions of Maryland, New Jersey, Virginia and West Virginia. Headquarters have been established at 3107 North Broad St. and Lee Myers, formerly of The American Engineering Co., will be associated with Mr. Vollbrecht.

Announcement was also made of the appointment of Engineering Products Co., F. E. Anderson, manager, to the Southern West Virginia field with headquarters at 304 Davidson Bldg., Charleston, W. Va.

A third appointment recently made was that of the Power Specialty Co., O. W. Muller, manager, with headquarters at 25 North Live Oak St., Houston, Tex., covering the Southeastern Texas territory.

NEWS FROM THE FIELD

The Middle Eastern District Meeting of the A.I.E.E. which was to have been held in Pittsburgh, Pa., in October, 1942, has been postponed indefinitely.

The Third Annual Water Conference, Engineer's Society of Western Pennsylvania, will take place in Pittsburgh November 9-10. Headquarters will be at the William Penn Hotel. H. M. Olson, 171 Longue Vue Dr., Pittsburgh, Pa., is chairman.

E. S. Taylor, director of the employes' suggestion system of The Pullman Co., was elected president of the National Association of Suggestion Systems at a meeting in Chicago August 12. Also elected at the meeting were F. A. Denz of United Air Lines as secretary and H. C. Marmaduke of the Illinois Central Railroad as treasurer. Three directors chosen in addition to the officers were H. W. Seinwerth of Swift & Co., F. R. Evers of the Public Service Co. of Northern Illinois, and H. F. Foley of the Peoples Gas Light & Coke Co.

N. B. Higgins, President of Safe Harbor Water Power Corp.

N. B. Higgins

FOLLOWING a meeting of the Safe Harbor Water Power Corp., announcement was made of the election of N. B. Higgins as president and director to fill the vacancy caused by the death of Frederick A. Allner. Notice of Frederick A. Allner's death is listed in the obituary column in this issue.

A graduate of Pennsylvania State College, Mr. Higgins is an engineer of long experience in the development of the hydroelectric resources of the lower Susquehanna River where the company's plant is located in Lancaster County, Pa. He was the chief engineer of the Safe Harbor Water Power Corp. and of the Pennsylvania Water & Power Co. Mr. Higgins played an important part in the planning, construction and operation of the Safe Harbor development.

Announcement is also made by the corporation of the promotion of Bartow Van Ness, Jr., formerly assistant to chief engineer to chief engineer, and of J. B. Homsher, an assistant in the purchasing department to purchasing agent.

Mr. Van Ness is a graduate in Electrical Engineering of Johns Hopkins University and Massachusetts Institute of Technology. As assistant to chief engineer, he was in charge of electrical engineering and design, assisting in the general engineering and system studies. At the time of the building of the Safe Harbor development Mr. Van Ness was the company's electrical engineer and responsible for the electrical design of the power plant.

● Water is a raw material and to use it "as is," when it can be improved by treatment, is to work at low efficiency insofar as water influences production, the process and the product.

Infilco equipment for boiler and evaporator feedwater treatment, cooling water conditioning, condensate oil removal, steam purification, etc., is engineered and built to meet your specific requirements by an organization with 48 years experience. Infilco's staff is always ready to help you with your problems.

INFILCO
INCORPORATED

325 W. 25TH PLACE, CHICAGO, ILL.
Formerly **INTERNATIONAL FILTER CO.**

INFILCO

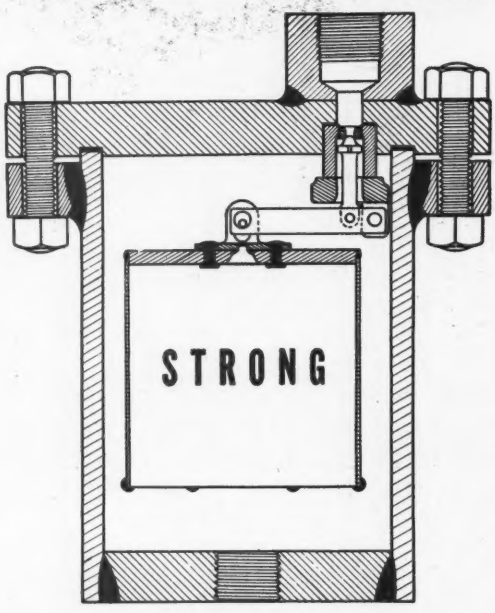
ACCELATOR SOFTENERS • CHEMICAL FEEDERS • PROPORTIONERS
WATER FILTERS • CLARIFIERS • COOLING WATER CONDITIONERS
CONDENSATE FILTERS • STEAM PURIFIERS • HOT-FLOW SOFTENERS
LIME-SODA SOFTENERS • ZEOLITE SOFTENERS • CATEXERS

INFILCO

PIPEWRENCH PETE SAYS:

New WELDED Steel Trap for high pressures

Certified Fabrication...Proved Design



Use WELDED *top quality* TRAPS for pressures to 600 lbs. (Temp. 750° F.)

You'll find these sturdy steel traps of proved design just right for high pressure, high temperature lines. STRONG certified operators and fabrication methods save manufacturing time and offer you striking economy without sacrificing rigid Strong quality.

WELDED (Series 90) TRAPS are constructed from seamless steel tubing—steel cover fastened with alloy steel bolts.

Such standard Strong features as—anti-balancing device, ANUM-METL valve-seat-pins, stainless steel bucket and lever. Internal bolted seat easily removed after years of service. *Write for information or call your Strong distributor.*

Strong, Carlisle & Hammond Company
1392 W. Third Street, Cleveland, Ohio

★ ★ ★ ★ ★ ★ ★ ★

WAR—Strong Specialties are now needed for war plants (explosives, chemicals, aircraft, ships, etc.) PLEASE CONSERVE present Strong equipment. Use repair parts to restore efficiency ... increase production ... save steam (fuel) ... save money.

14

STRONG
STEAM SPECIALTIES

National Power Show Opens Nov. 30

THE 15th National Exposition of Power and Mechanical Engineering, scheduled for Grand Central Palace, November 30 to December 5, will be celebrating its 20th year of service to industry. The management announces that 170 spaces have already been definitely engaged by 137 concerns, and there will probably be at least 175 displays by the time the exposition opens.

A wide variety of timely displays will feature the Power Show which is being planned as a direct aid to war production. It is expected that the exhibits will be of particular interest to engineers and operating men who are faced with many new production and maintenance problems, as well as the many new men with industrial responsibilities.

Copper & Brass Research Officers

ROBERT L. COE, vice-president of Chase Brass & Copper Co., Inc., Waterbury, Conn., was elected president of the Copper & Brass Research Association at its 22nd annual meeting at the Hotel Biltmore. He succeeds Mr. John A. Coe, president of The American Brass Co., Waterbury, Conn.

Elected as vice-presidents were John A. Coe, president, The American Brass Co.; Wylie Brown, president Phelps Dodge Copper Products Corp.; R. E. Day, president Bridgeport Brass Co.; C. L. Smith, treasurer, The National Copper & Smelting Co.; and Wm. M. Goss, vice-president, Scovill Mfg. Co.

C. Donald Dallas, president, Revere Copper and Brass, Inc., was elected treasurer; T. E. Veltfort, and Bertram B. Caddle, secretary. The Board of Directors, in addition to the officers, includes R. L. Coe, J. A. Doucette, A. W. Wilkinson, S. H. Perry, Otto Z. Klopsch, and F. L. Riggin.

War on Fuel Waste

UNDER the auspices of the American Society of Heating and Ventilating Engineers and the Stoker Manufacturers Association, a war on fuel waste program on a nation-wide basis was started August 17. The war service committee of the A.S.H.&V.E. with B. M. Woods, professor of mechanical engineering at the University of California, as chairman is actively in charge of the campaign.

Part of this campaign consists of a fuel user's pledge as follows:

To order my fuel early, to anticipate my needs and keep stock piles up so as to equalize and conserve transportation and delivery facilities and to prevent tie-ups and shortages next winter.

To see that my heating plant is clean and kept clean.

To have my heating system inspected by a competent heating engineer or contractor.

To have recommended repairs or alterations essential to efficient operation of the heating equipment made in August and September.

To install storm windows, weatherstripping, insulation and do everything practical to reduce heat losses.

To carefully follow instructions on how to operate my heating system properly.

To prevent smoke because smoke means waste and inefficiency.

To keep room temperatures at 68-70 degrees and avoid over-heating because it endangers efficiency and health.

To conserve heat and fuel at all times.

Recommend 48-hour Week in War Plants

EIGHT Government agencies on July 28 recommended to war contractors and other war producing agencies a reexamination of hours and working conditions to improve worker efficiency and production by four major standards:

1. For wartime production the eight-hour day and 48-hour week approximate the best working schedule for sustained efficiency in most industrial operations.

2. One scheduled day of rest for the individual, approximately every seven, should be a universal and invariable rule.

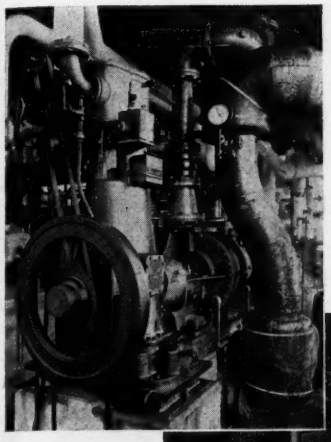
3. A 30-minute meal period is desirable.

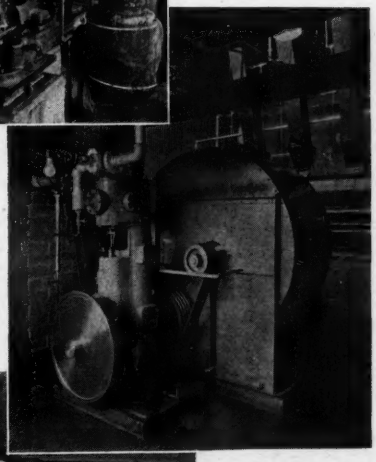
4. Vacations are conducive to sustained production. They should be staggered over the longest possible period.

The recommendation in no way affects the Wage-Hour Act's provision requiring time and one-half pay for all overtime work after 40 hr. a week.

Drive by
STEAM ENGINE

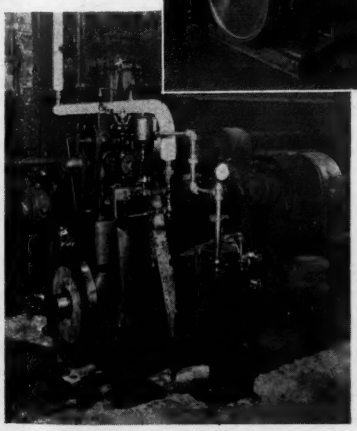
. . . it's the modern way to reduce power costs and to obtain certain desirable drive characteristics

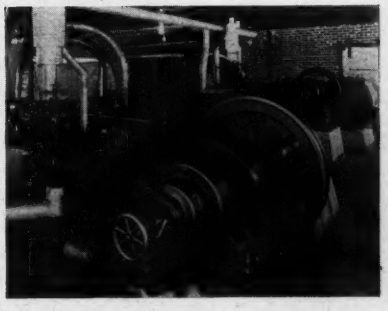


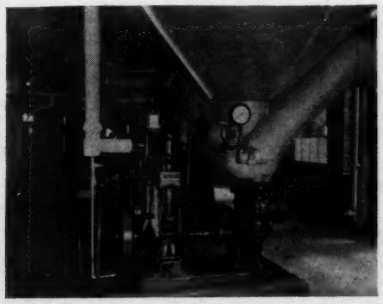


IF a steam engine can drive a stoker, pump, compressor, fan, or any other auxiliary equipment at the lowest cost, *it's the most modern drive you can get.* If, in addition, it gives you unsurpassed dependability, high torque and ability to handle sustained overloads, low conservative speeds suitable for direct connections . . . if you get these advantages, too, you are getting a drive that will be most useful in many installations.

Troy-Engberg Steam Engines are now heading toward the sea by the hundreds. We're busy producing them as part of Troy-Engberg Generating Sets for the Liberty Ships. But keep these facts in mind when you are in a position to buy—and we to sell—steam engines for general industrial use.







TROY ENGINE & MACHINE CO.

Established 1870

845 Railroad Ave., TROY, PA.

9-TEM-1

Fairbanks Valves are valves that can be depended on for the maximum in years of useful, carefree service. Because they are long lasting, they are of outstanding value as a means of helping to keep plants going and of protecting against "down time." Their long life not only minimizes maintenance but extends the time until replacements become necessary.

In assuring maximum years of service, Fairbanks Valves can be depended on for low cost performance per year of service, because their long-lasting qualities are available without having to pay a premium in price.

Service life of Fairbanks Valves is further extended in Fairbanks Renewable Valves through ability to replace worn parts quickly and easily.

The nearest Fairbanks distributor is ready to assist you. If you don't know him, we'll gladly introduce you. Just ask us.

Have you a copy of the Fairbanks catalog No. 21?

1. **Prompt service through conveniently located distributors.**
2. **Standard and Renewable types for practically every need.**
3. **Quality in design, materials and workmanship.**
4. **Uninterrupted service.**
5. **Low in maintenance cost.**
6. **Maximum years of service assured.**
7. **Acclaimed for dependable performance.**
8. **Nationally accepted by users.**
9. **Backed by over 50 years' specialized experience.**
10. **Technical assistance in valve selection.**

THE FAIRBANKS COMPANY
399 Lafayette St., New York, N. Y.
Boston, Mass., Pittsburgh, Pa.

Electric Company to Expand

THE Indiana & Michigan Electric Co., South Bend, Ind., is completing plans for a new addition to the Twin Branch steam-electric generating station near Mishawaka, Ind. Structure will be about 105 by 133 ft., and 207 ft. high, for expansion in turbine room and boiler house, respectively. An adjoining building will be constructed, approximately 66 by 76 ft., and 88 ft. high, for storage and auxiliary station service. It is expected to award construction contract in near future, with work reported to cost close to $500,000, exclusive of primary equipment. Capacity of plant will be increased.

Trained Seamen Urgently Needed

CAPTAIN EDWARD MACAULEY, Deputy Administrator of the War Shipping Administration and a member of the United States Maritime Commission, said in a radio interview over the Blue Network that there is a pressing need for men with sea experience to return to the sea in order to man the new fleet of Liberty Ships and other vessels composing the American Merchant Marine.

Pursuant to the provisions of Executive Order Number 9198, dated July 11, functions for training Merchant Marine personnel have been transferred to the Administrator of the War Shipping Administration.

Hydroelectric Plants to be Built

BUREAU of Reclamation, Denver, Colo., will prepare plans at an early date for the development of five new hydroelectric generating stations at different multi-purpose irrigation projects in the Western part of country. Exact location of the respective projects has not yet been announced. Project will include power dams, generating stations, switching stations, power substations and transmission lines and is estimated to develop a total of 1,055,600 kw. capacity. Projects have been authorized by the Department of Interior, Washington, D. C., and priority ratings are being granted by the WPB. Work is scheduled to begin in early fall, with completion of the entire group project in 1944. This expansion, it is stated, will provide a total rating of 2,500,000 kw. at Federal hydroelectric power plants in 12 States under the direction of the Bureau.

Mexican Project to Use American Equipment

ALTOS HORNOS de Mexico, S. A., Monclova, State of Coahuila, Mexico, has plans maturing for large steel mill on local site, and has concluded arrangements with the Export-Import Bank, Washington, D. C., for a loan of $6,000,000, to provide in part for the project. This fund, it is said, will be used primarily for the purchase of required machinery and equipment in the United States, including both new and reconditioned machinery. The plant will be of a thoroughly modern type, electric-operated, and will comprise several large one and multi-story buildings for different branches of production. It will be developed for large capacity. Installation will include motor-generator sets, heavy-duty motors and controls, switchgear, transformers and other equipment and facilities. It is understood that a power plant will be built for service at the mill.

Enginemen Needed in Federal Buildings

ENGINEMEN (steam-electric) are needed to be in charge of heating, refrigerating, and ventilating systems in Federal buildings in Washington, D. C. The United States Civil Service Commission is recruiting enginemen for positions paying from $1,680 to $2,040 a year.

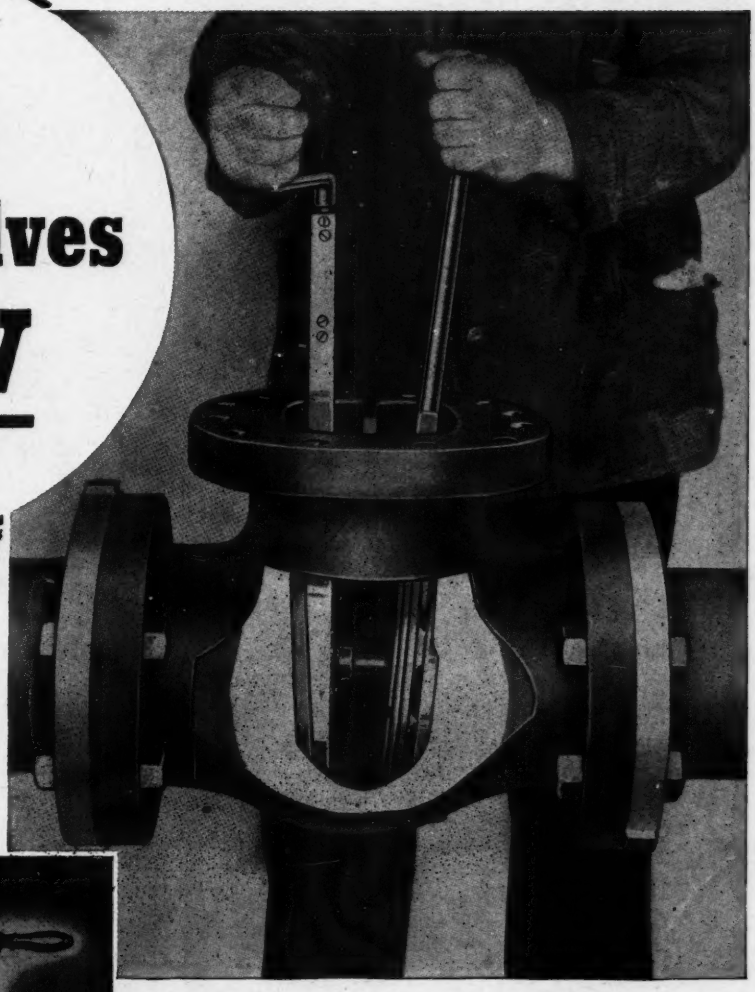
The Federal civil service offers enginemen the opportunity to gain experience in diversified types of equipment. Advancement may be rapid, depending on the ability of the individual to accept responsibility and to broaden his knowledge.

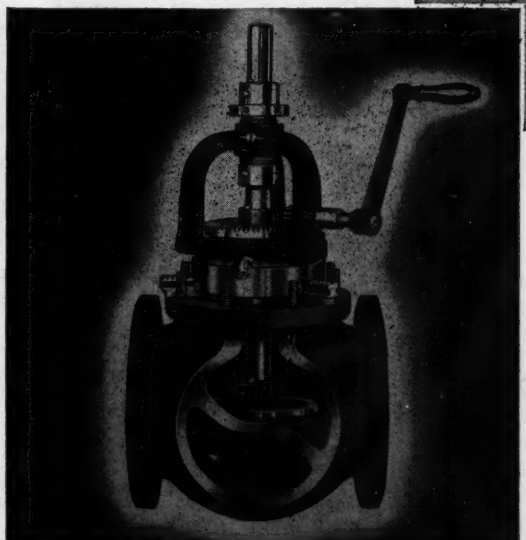
Experience in the operation or installation of air-conditioning equipment will be accepted as qualifying. Applicants for all positions must show experience with electrical machinery. Experience in the operation of Diesel, air-conditioning, or refrigerating equipment is desirable, but not essential.

There is no education requirement nor age limits. Filing application forms, obtainable at first- and second-class post offices, is all that is necessary to be considered. Applications must be filed with the Civil Service Commission, Washington, D. C., and will be accepted until further notice. Qualified persons are urged to apply at once.

FIX Leaky Valves NOW

No Waiting for Parts—





In less than an hour's time, any mechanic using a Dexter Valve Reseating Machine can make a valve seat and disc or gate absolutely tight.

No need to remove the valve from the line, no unnecessary delay, no waiting for parts. Dexter equipment will reseat monel, stainless steel, and stellite, as well as brass and bronze seats.

Put an end to leaky valves that waste steam, air or water that may cause a shutdown while you wait for parts. Order a Dexter Valve Reseating Machine today.

Capacities: Globe valves, ¼" to 14"; Gate valves, 1½" to 48"; Pump valves, 1½" to 15".

LEAVITT MACHINE TOOL CO., 506 EAST RIVER STREET, ORANGE, MASSACHUSETTS

DEXTER

Valve Reseating Machines

Pick 'em to Last!
Be it fillies or fittings, endurance counts.
● Avoid future procurement troubles by installing W-S High-Pressure, High-Temperature Fittings now—even where pressures and temperatures are only moderate. These fittings will last far longer in any installation — through future months when all fittings may be more difficult to obtain. Service records prove their long life outweighs the additional cost.
Check the facts yourself, in free Bulletin A-3. It presents full information on the wide available range of sizes and pressure ratings in both welding and screw-end types. Order through your regular Mill Supply Distributor.
THE WATSON-STILLMAN CO.
ROSELLE, NEW JERSEY
Engineers and Manufacturers of Forged Steel Fittings and Valves, Hydraulic Machinery and Equipment—Hydraulic Presses, Pumps and Jacks
W S
Look for the double-diamond trade-mark
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2521

Conversion to Other Fuel Saves Oil

VOLUNTARY conversions by East Coast consumers of heavy fuel oil continue to soar upward, with a total of 21,232,000 barrels being saved annually by 784 firms reporting as of July 23, Petroleum Coordinator Ickes announced July 30. This is an increase of 1,604,000 barrels since June 12, when 520 concerns consuming 19,628,000 barrels per year had converted. The 58,171 barrels of oil now being saved daily represent 5540 tank cars that are thus relieved from service to haul fuel oil for essential Atlantic seaboard needs.

Fuel oil deliveries on the Atlantic Coast will be further restricted until September 15, at the request of the Office of Petroleum Coordinator for War. The delivery control is set up by an amendment (No. 2) to Limitation Order L-56. During the period August 3-September 15, there can be no deliveries of fuel oil for the operation of heating and cooling equipment in Area One, which embraces most of the 17 East Coast States and the District of Columbia.

Iron and steel necessary to facilitate the conversion of oil burning furnaces to coal was allocated Aug. 1 by the War Production Board to assure manufacture of grates and equipment for installation before winter.

This action helps clear the way for conversion. All a home owner or plant operator need do is to place his order for the necessary equipment with his local plumbing and heating contractor or dealer. No papers are required.

In order to get iron and steel for grates a manufacturer should file form PD-25F, if he is operating under PRP, or form PD-1A if he is not. Ratings authorized by the Requirements Committee will be assigned to these application forms by the Plumbing and Heating Branch.

Indiana Utility Starts New Station

THE PUBLIC SERVICE CO. of Indiana recently announced that excavation had started for the foundation and substructure of a new 50,000 kw. generating unit to be installed at Dresser Station near Terre Haute, Indiana.

Major equipment for this addition was ordered last November but was delayed due to diversion of turbines and steel supplies for war purposes. The project now has an A-1 preference rating for the necessary steel.

In capacity and general design, this No. 5 unit will be similar to No. 4, a 50,000 kw. unit put into service earlier in the year. The extension will be on the north side of the building and it is scheduled for completion by November 1. This will increase the station's generating capacity to a total of 175,000 kw. The estimated cost is $4,245,000.

WPB Halts Work on 85 Power Plants

A TOTAL of some 2,200,000 kw. in 85 plants scheduled for completion in 1943 and 1944 were affected by a WPB order effective Aug. 21. Priority ratings on public and private projects urgently needed for the war effort were stepped up at the same time critical materials were withheld from the others. Some 5,500,000 kw. of new capacity, mostly scheduled for early completion, is provided under the new program. Of this some 3,400,000 are in private plants. In addition to the 85 mentioned above, 28 government projects were given low ratings or left in the initial status. Work on these will proceed to the point where they do not compete for materials needed for war.

Among the projects listed as "halted or suspended in whole or in part", (without reference to the date of suspension or designation of the units affected) were:

Albuquerque Gas & Elec. Co., Albuquerque, N. M.; Austin, city, Austin, Minn.; Bellefontaine, city, Bellefontaine, O.; Berea, city, Berea, O.

Municipal plant, Columbus, O.; Columbus (O.) & Southern Ohio Elec. Co., Picway and Walnut Streets; Consumers Power Co., Michigan, Weadock, Mich.

Dallas (Tex.) Power & Light Co.; Mountain Creek; Dayton (O.) Power & Light Co., Millers Ford; Des Moines Electric Light Co., Des Moines, Ia.

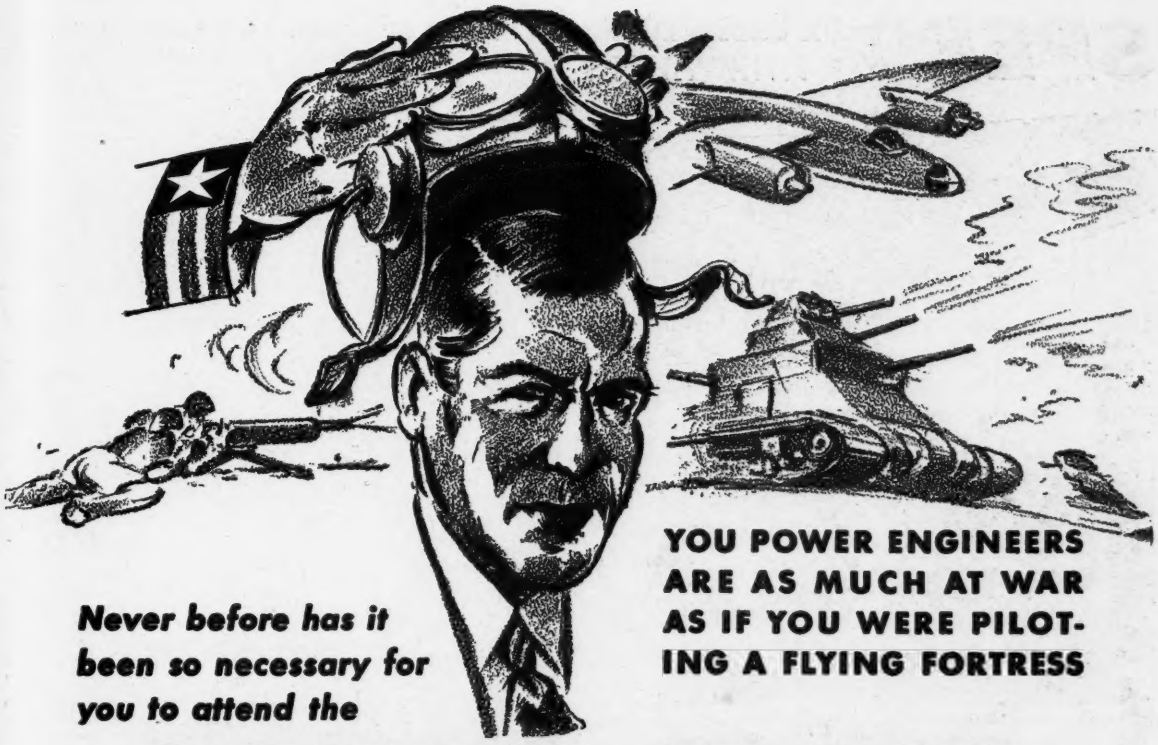
Ephrata, borough, Ephrata, Pa.; Fairmont, city, Fairmont, Minn.; Farmers Electric Generating Corp., Gilmer, Tex.; Fort Dodge Gas & Elec. Co., Fort Dodge, Ia.

Glendale, city, Glendale, Cal.; Gunnison, town, Gunnison, Colo.

Iowa Elec. Light & Power Co., Marshalltown, Ia.; Iowa Elec. Light & Power Co., Boone, Ia.; Iowa Public Service Co., Sheldon, Ia.

Jersey Central Power & Light Co., Raritan River; Kansas City (Kan.), Quindaro; Kansas City (Mo.) Power & Light Co., Grand Ave.; Kentucky Utilities, Tyron, Ky.

Los Angeles, Cal., city, harbor (two projects); Marshfield, city, Marshfield, Wis.; Metropolitan Edison Co.,



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That's why a new kind of Power Show is planned in this unprecedented year in our nation's industrial history. That's why in the 1942 Power Show there is but one aim: to help American engineers solve their wartime production and maintenance problems — to help win the war.

Judged by advance information, by the already-announced plans of many prominent exhibitors, engineers can look forward to a unique educational opportunity. For the tone of this year's Power Show is in keeping with the gravity of the hour, grimly serious — a factual, realistic pooling of helpful, tested ideas. In place of the frills of peacetime showmanship, you are offered a clearing-house of engineering information about products and methods that have proved themselves under the necessary restrictions of total war.

You may be studying problems such as conversion from liquid fuel to coal. Or, perhaps, how to make present equipment produce more power.

There's no better, no more practical way of finding answers to the vital questions of the day than attending the 1942 Power Show. Plan to get *all* the benefits, all the inspiration that a free interchange of ideas can bring to an inquiring mind. See successful wartime power plant practice demonstrated in graphic, instructive exhibits. Discuss your problems with authoritative technical men, men to whom "High-Pressure" is an engineering term and not a selling technique.

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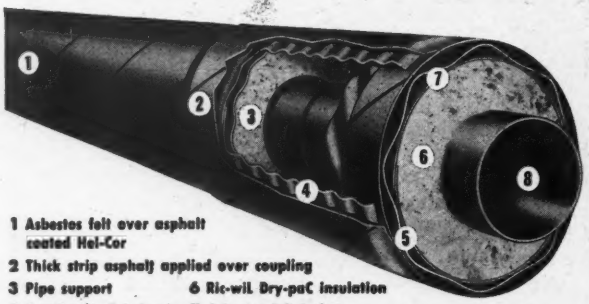

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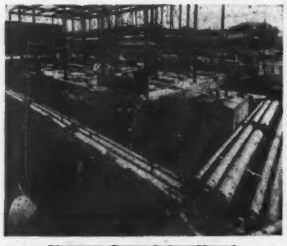
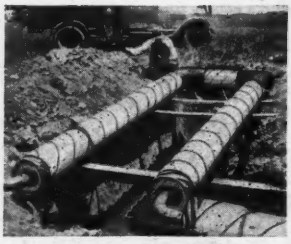
6 Ric-wil Dry-paC insulation
7 Asbestos felt jacket
8 Steam pipe



Lines at Great Lakes Naval Training Station.



Expansion loop. Note sliding type pipe supports.

Speed is the prime requisite on wartime construction. Use Ric-wiL Pre-sealed Insulated Pipe Units for the protection and insulation of all underground and outside overhead steam, fuel oil, and hot water piping. These factory pre-fabricated units are reasonable in cost. Note these salient facts:

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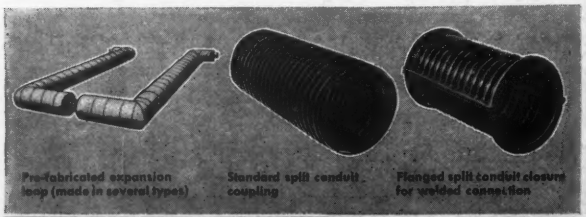

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New Jersey Power & Light Co., Gilbert; Northwestern Public Service Co., Aberdeen, S. D.; Ohio Edison Co., Toronto, O.; Ohio Power Co., Tidd; Ohio River Power Co., Dilles Bottom.

Pacific Gas & Elec. Co., Midway, Cal.; Pacific Gas & Elec. Co. (indefinite); Pennsylvania Power & Light Co., Williamsport; Philadelphia Electric Co., Southwark; Public Service Co. of Ind., Edwardsport; Public Service of Oklahoma, Tulsa.

Reading, city, Reading, O.; Richmond, city, Richmond, Ind.; San Antonio (Tex.) Public Service Co., station B; San Diego (Cal.) Gas & Elec. Co., Silver Gate.

Southern Indiana Gas & Elec. Co., Ohio River Station; Southern Indiana Power Co., Rushville, Ind.; Springfield Gas & Elec. Co., Springfield, Mo.; Southwestern Gas & Electric Co., Caddo Lake; St. Joseph Railway, Light, Rapid Transit and Power Co., Missouri, Lake Road.

Tacoma (Wash.), city, Alder, Nos. 1 and 2; Tarentum, borough, Tarentum, Pa.; Traverse, city, Traverse City, Mich.

Windom, city, Windom, Minn.; Wisconsin Hydro Electric Co., Clear Lake, Wis.; Wisconsin Power & Light Co., Beloit, Wis.

Government projects proceeding on low priorities or unrated were:

Tennessee Valley, Wilson No. 15, No. 16, Alabama; Watts Bar No. 4 (steam), Tennessee; Pickwick No. 5, Tennessee; Fort Loudon Nos. 3 and 4, Tennessee; Guntersville No. 4, Alabama; Chickamauga No. 4, Tennessee; Wautaga Nos. 1 and 2, Tennessee; Wheeler Nos. 5 and 6, Alabama; South Holston Nos. 1 and 2, Tennessee; Wilson (steam), Alabama; Fontana No. 3, North Carolina; Kentucky Nos. 3, 4 and 5, Kentucky.

United States Engineers—Markham Ferry, Oklahoma; Wolf Creek, Kentucky; Center Hill, Tennessee; Fort Peck No. 2, Montana; Fort Gibson, Oklahoma; Denison No. 2, Texas-Oklahoma.

United States Bureau of Reclamation—Colorado-Big Thompson, Colorado; Anderson Ranch, Idaho; Keswick No. 3, California; Davis Nos. 1, 2, 3, 4 and 5, Arizona-Nevada.

Federal Works Agency—Pensacola, Okla.

Bonneville Administration—Grand Coulee Nos. 7, 8 and 9, Washington.

Obituaries

Frederick A. Allner

F. A. Allner

FREDERICK A. ALLNER, president of the Safe Harbor Water Power Corp., Baltimore, Md., died July 18 at the Union Memorial Hospital.

Mr. Allner, one of the leading electrical engineers of the country, received his degree of mechanical engineer from the Technical College, Prague, which later in view of his achievements conferred on him a doctor's degree. He took post-graduate courses at the Polytechnic College, Zurich, and the Electro Technical College, Karlsruhe. His engineering career began in Canada where he was associated with the Montreal Locomotive Works and later as an engineer with the Shawinigan Water & Power Co. in its hydroelectric development in the Province of Quebec.

In 1909 he came to Lancaster County, Pa., in connection with the hydroelectric development which the Pennsylvania Water & Power Co. completed and placed in operation on the Susquehanna River at Holtwood, Pa. He was at first assistant chief engineer, then general superintendent, later becoming vice-president of the Pennsylvania Water & Power Co. He covered supervision of electrical, mechanical and hydraulic design, construction and operation of the Holtwood project; the building of the auxiliary steam plant at Holtwood and the high tension lines which form a regional network of power supply to public utilities in Lancaster, York, Coatesville, Pa., Baltimore, Md., and Washington, D. C. He became general superintendent of the Safe Harbor Water Power Corp. in 1929 and was elected President in 1940. He was the engineering member of the Maryland State Board of Health, past President and honorary life member of the Engineers Club of Baltimore, a member of the Engineers Club of Philadelphia, A.I.E.E., A.S.M.E., A.S.C.E., the Newcomen Society, the Baltimore Safety Council, the Safety Engineering Club, and the Society of American Military Engineers.

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Frank S. Dunham

FRANK S. DUNHAM, associated with The Permutit Co. in the sale of water conditioning equipment for approximately 25 yr., died in Chicago on July 23.

Born in Baltimore, Md., on March 8, 1876, Mr. Dunham began his engineering studies at the Armour Institute of Technology and completed his work in chemical engineering at the University of Chicago. His career in engineering began with the Hydrox Corp. of Chicago upon graduation from the University. Subsequently, he was a chemical engineer with the Kennicott Co. until he became associated with The Permutit Co. He retired in 1940. Mr. Dunham served as a Captain in the Illinois National Guard, and was a veteran of the Spanish-American War.

Mark W. Potter

MARK WINSLOW POTTER, 77, president of the Pennsylvania Coal & Coke Corp., and a former member of the Interstate Commerce Commission of New York, from 1920 to 1925, died at his home in New York City, August 12.

Born in Kanesville, Ill., Mr. Potter was a graduate of New York University and was admitted to the bar in 1888. He served as receiver of the Chicago, Milwaukee & St. Paul Railroad until 1928, and was a member of the New York City and State Bar Associations.

John B. Nicholson

JOHN B. NICHOLSON, founder and president of the J. B. Nicholson Corp., 30 Rockefeller Plaza, New York City, died August 8 at his home in Scarsdale, N. Y.

Mr. Nicholson, 59, was born in Toronto, Ontario, Can., and was a graduate of the University of Toronto. He founded the engineering firm 28 yr. ago.

George A. Bradley

GEORGE A. BRADLEY, 70, who for 20 yr. served as chief of plants for the board of water and light commissioners at Lansing, Mich., died July 31 at St. Lawrence Hospital in Lansing.

Mr. Bradley was born in New York City and had been employed by the Allis-Chalmers Co. at Milwaukee for over 25 yr. before coming to Lansing. He had been an erector of power plant equipment and was a member of the Engineer's Club of Lansing.

Milton Theodore Thompson

MILTON THEODORE THOMPSON, 72, retired civil and electrical engineer, died August 9, at his home in Upper Montclair, N. J.

Mr. Thompson, a graduate of Simpson College, and a native Chicagoan, started work for the Western Electric Co. in 1893. In 1895 he went to Mexico where he became chief engineer in construction of the Necaxa Dam. In 1912 he returned to the United States and shortly thereafter went to Spain, where he made a survey of hydroelectric power projects. On his return to this country he was in charge of building the Keokuk Dam near St. Louis.

Arthur Ginn

ARTHUR GINN, associate sales manager of the New York District Office of Combustion Engineering Co., Inc., died suddenly on July 18 at Ogunquit, Maine, where he had been vacationing.

Mr. Ginn joined the sales force of the company in 1918 and represented it in upper New York State. He resided in Scarsdale and was a member of the New York, Boston and Rochester Engineers' Clubs.

John L. Bossert

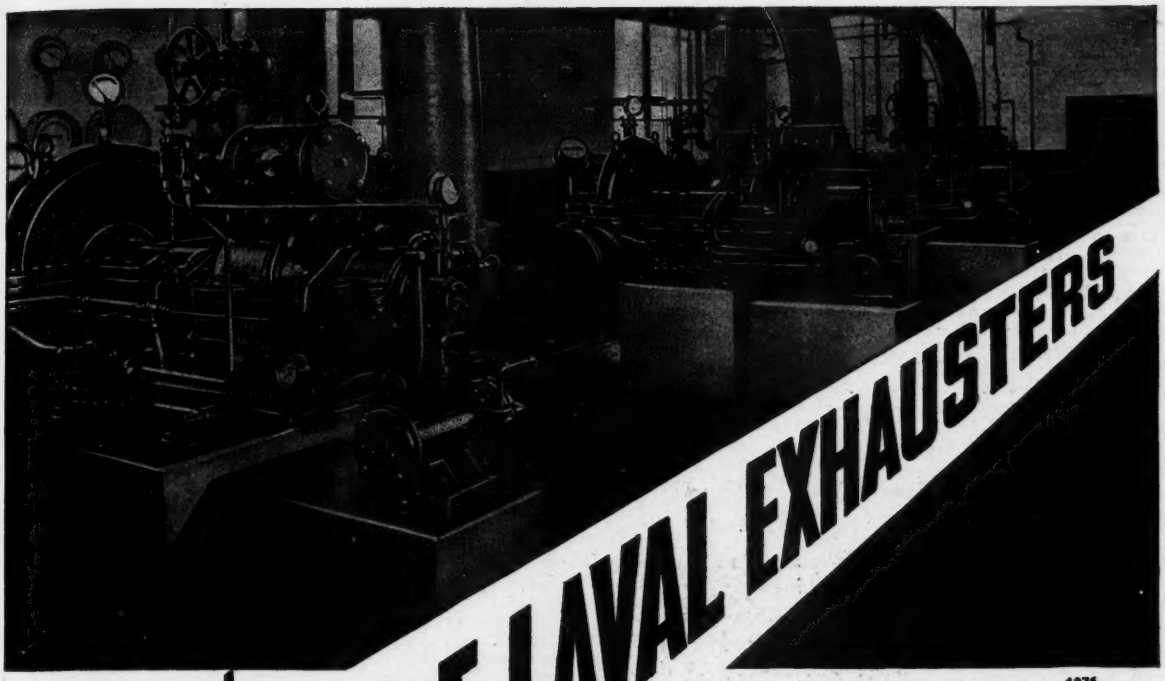
JOHN L. BOSSERT, sales engineer for the Ward Leonard Electric Co., Mount Vernon, N. Y., for the past 17 yr., died at his home in that city July 9th.

Mr. Bossert, after a period of teaching at Cooper Union, New York, where he obtained his degree in Electrical Engineering, joined the sales force of Ward Leonard. He had been in charge of sales engineering work on Naval and Marine equipment for the company.

Edwin H. Brevillier

EDWIN H. BREVILLIER, 64, president of the Union Iron Works, Erie, Pa., died at his residence in Erie following an illness of nine weeks.

Mr. Brevillier had been associated with the company since 1906, and was elected president in 1941. He attended the University of Pennsylvania, and was active in civic life in Erie.



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Power Plant Construction News

Ala., Holt—Reichhold Chemicals, Inc., 601 Woodward Heights Blvd., Ferndale, Detroit, Mich., manufacturer of industrial chemicals, plans installation of electric power equipment in new branch plant at Holt, comprising group of seven buildings. A power house is planned. Work will begin soon. Entire project is reported to cost close to $2,000,000.

Ark., Little Rock—War Department, Washington, D. C., has authorized new air force training school in vicinity of Little Rock, comprising large group of buildings. A boiler house and power substation are planned, with complete electric light and power distribution system. Entire project will cost over $4,000,000, and will be carried out under direction of U. S. Engineer Office, Little Rock.

Calif., Los Angeles—Norris Stamping & Mfg. Co., 5215 Boyle Ave., Vernon, manufacturer of stamped metal goods, has plans for new boiler house at plant, about 40 by 47 ft. Cost reported over $30,000, with boiler unit, pumps and auxiliary equipment. Webber & Co., Hollingsworth Building, Los Angeles, are consulting engineers.

D. C., Washington—Potomac Electric Power Co., Washington, has arranged for a bond issue of $5,000,000, proceeds to be used primarily in connection with expansion in steam-electric generating station at Buzzard Point, now under way. Capacity of plant will be increased. Also will make extensions in transmission lines, with new power substations and other facilities.

Ga., Columbus—Nehi Corp., Tenth Ave., manufacturer of bottlers' syrup and kindred specialties, has approved plans for new 2-story cold storage plant in vicinity of factory. Cost estimated about $45,000, with equipment.

Ill., Chicago—Darling & Co., 4201 South Ashland Ave., manufacturer of commercial fertilizers, has filed plans for addition to boiler house at plant, to be 30 by 40 ft., and 50 ft. high. No estimate of cost announced. Work is scheduled to begin soon. Solon L. Reily, 300 West Adams St., is architect.

Ind., Indianapolis—RCA Mfg. Co., 501 N. LaSalle St., Indianapolis, manufacturer of radio and talking machine products, plans installation of electric power equipment in new 1-story plant addition at Indianapolis, about 110 by 500 ft. Cost reported over $400,000. H. K. Ferguson Co., Hanna Building, Cleveland, Ohio, is engineer for design and construction. Main offices are at 411 Fifth Ave., New York, N. Y.

La., New Orleans—New Orleans Public Service Co., 317 Baronne St., is completing plans for addition to steam-electric generating station at Market and St. Peters Streets, with installation of additional equipment for increased capacity. Cost reported close to $180,000, exclusive of equipment. Proposed to carry out work soon. Ebasco Services, Inc., 2 Rector St., New York, N. Y., is consulting engineer.

Mass., Hingham—Bethlehem-Hingham Shipyards, Inc., will soon begin construction of new compressor station in conjunction with boiler house at local shipbuilding plant, now in course of construction. Cost reported over $60,000, with equipment. Company is affiliated with Bethlehem Steel Co., Shipbuilding Division, Quincy, Mass.

Mich., Ypsilanti—City Council plans installation of pumping machinery and auxiliary equipment in connection with expansion and improvements in municipal water plant; work will include additions to water filtration and softening plant, and is reported to cost in excess of $600,000. Financing is being arranged through Federal aid.

N. Y., Brooklyn—Finest Steam Laundry, Inc., 199 Bogart St., has filed plans for new boiler plant, about 25 by 50 ft., at 32 Meadow St., and will begin erection soon. No estimate of cost announced. Martyn N. Weinstein, 93 Court St., is architect.

Advertising's Part In Engineering Progress

Advertising tends to reduce rather than increase the percentage expense of selling. It reduces the risks of capital and the loss from idle capital. It tends to establish high standards of business morality, since misrepresentations go on record, and can afterwards be used to the offender's disadvantage. It tends to expedite and simplify the work of both buyer and seller. It leads to the education of the buyer as to the latest and most improved processes and methods.

It removes largely the personal factor and encourages intelligent and discriminating buying; bulldozing, wheedling and jollying are impossible in an advertisement; it is effective in proportion to its content of fact and argument. It leads to the perfection of the product in order that the latter may have the strongest claims to the buyer's consideration. It stimulates and produces to a high level of attainment. And, finally, it accelerates engineering progress and makes engineering more profitable, thereby multiplying and popularizing the benefits of science.

—Geo. H. Gibson
Advertising Engineer

Ohio, Canton—Ohio Power Co., Canton, has approved plans for new addition to Wagenhals power substation, with installation of equipment for large increased capacity. Work will be carried out at early date. Cost reported close to $450,000, with transmission line extensions.

Ohio, Cleveland—Harris-Seybold-Potter Co., 4510 E. Seventy-first St., Harris Division, manufacturer of printing presses, parts, etc., has approved plans for new boiler house at plant, for which superstructure will begin soon. Cost estimated close to $50,000, with equipment.

Ohio, Euclid—Chase Brass & Copper Co., 1155 Babbitt Rd., Cleveland, O., manufacturer of metal products, plans installation of electric power equipment in new 1-story addition to plant at 1121 E. 260th St., Euclid, about 120 by 250 ft. Cost estimated about $200,000, with machinery. Work will be placed under way at once.

Ohio, Luckey—National Lead Co., 111 Broadway, New York, N. Y., plans installation of electric power equipment in new plant in vicinity of Luckey, for production of magnesium and magnesium alloys for Government. It will comprise several large units. A power house is planned. Entire project is reported to cost over $5,000,000, with financing provided by Defense Plant Corp., Washington, D. C. United Engineers & Constructors, Inc., 1401 Arch St., Philadelphia, Pa., is engineer in charge of erection. Company has organized Magnesium Reduction Co., Inc., as a subsidiary to carry out project.

Ohio, Vandalia—Board of Public Affairs plans new pumping station and installation of motor-driven pumping units and accessories in connection with extensions in water system. A new 300,000-gal. reservoir will be built. No estimate of cost announced. Bids will be asked soon. George Steller, U. B. Building, Dayton, O., is consulting engineer.

Ore., Vale — Malheur Cooperative Electric Assn., Vale, plans new power substation. Cost estimated about $50,000, with transformers, switchgear, etc. Proposed to begin work soon.

Pa., Erie—Lord Mfg. Co., Twelfth St. and Green Garden Rd., manufacturer of mechanical products, plans installation of electric power equipment in new 1-story plant addition, about 60 by 300 ft. Cost over $90,000. Proposed to begin work soon.

Pa., Philadelphia — Warner Co., Inc., 219 N. Broad St., Philadelphia, building materials and supplies, plans installation of electric power equipment in new magnesite mill to be erected for production for Government (exact location withheld). A power house is planned. No official estimate of cost announced, but will represent large investment. Financing will be provided by Defense Plant Corp. United Engineers & Constructors, Inc., 1401 Arch St., Philadelphia, is engineer in charge of design and erection.

Texas, Bryan—War Department, Washington, D. C., plans installation of electric light and power facilities, with power substation unit, in connection with new air force training school in vicinity of Bryan. Hangars, shops and other buildings will be erected, with installation of electric power equipment for operation. Entire project will cost over $2,000,000, and will be supervised by U. S. Engineer Office, Galveston, Tex.

Texas, Houston — Water Department, C. L. Fugate, chief engineer, plans installation of pumping machinery and auxiliary equipment in connection with development of new water source on San Jacinto River for increased supply for industrial area. Entire project will cost close to $1,500,000. Proposed to arrange financing through Federal aid.

Texas, Velasco — Dow Chemical Co., Midland, Mich., plans installation of electric power equipment in new multi-unit mill in vicinity of Velasco, for production of styrene, an ingredient of synthetic rubber. A power house will be built. Entire project is reported to cost about $18,000,000, with financing provided by Defense Plant Corp. Work is scheduled to begin soon. Stone & Webster Engineering Corp., 49 Federal St., Boston, Mass., is engineer for design and construction.

Wis., Milwaukee—Karr Mfg. Co., Inc., 1825 S. Kinnickinnic Ave., manufacturer of machinery parts, etc., plans improvements and addition to boiler house at factory at 2165 S. First St., to be occupied for expansion. Also will remodel and improve 4-story plant at last noted location, with installation of electric power equipment. Entire project is reported to cost over $45,000. Roger A. Sutherland, 259 E. Wells St., is architect.

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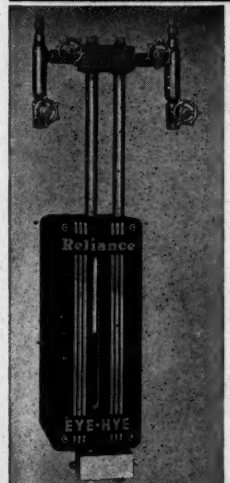

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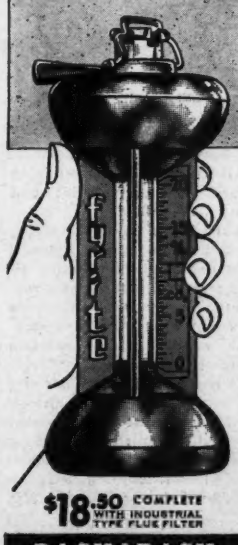

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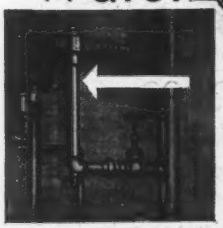

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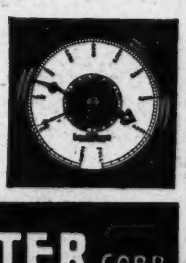

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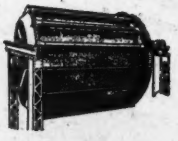

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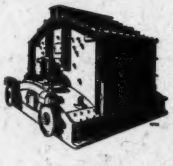

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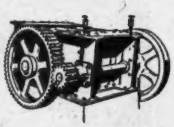

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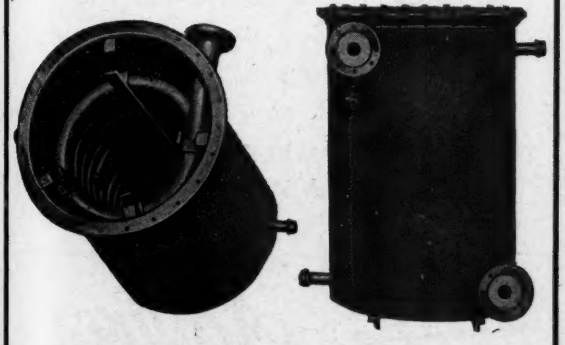

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Globe, Fig. 214a.

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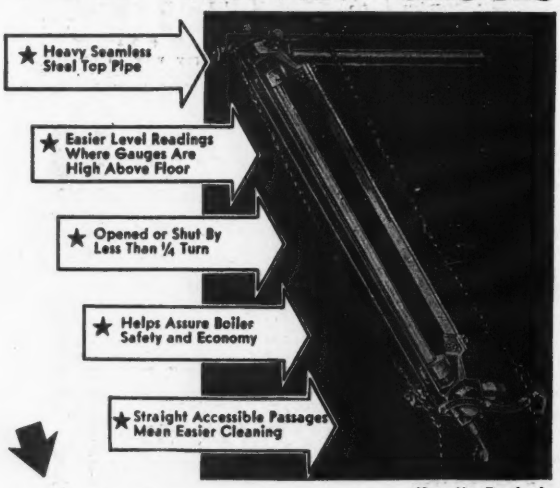
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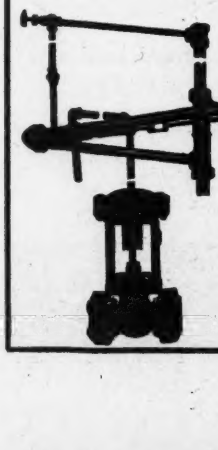

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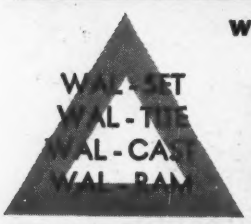

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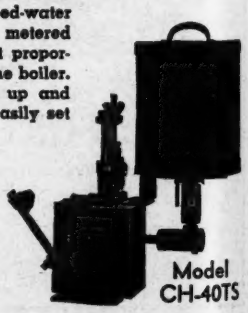
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In renewing the disc, note how easily and quickly the Vulcodisc Jiffy Disc Holder slips off the stem head. Only the disc lock nut to remove and the old disc is off and replaced in a jiffy.

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Cincinnati, Ohio

Now 65 YEARS
OF "KNOW HOW"
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Westco, the original horizontal turbine type pump with renewable liners, having established an outstanding performance record during the past 25 years on hundreds of thousands of applications, is now ready for even greater service.

For now the engineering "know how" of Pomona Pump Co.'s 40-year leadership in the industry have been added to Westco's background, resulting in a still better, tougher, longer-lived pump. Production has been stepped up far beyond any previous record—and wider distribution has resulted, much of it in new fields.

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With Westco, simply renew the liners (arrows) and you renew the pump!

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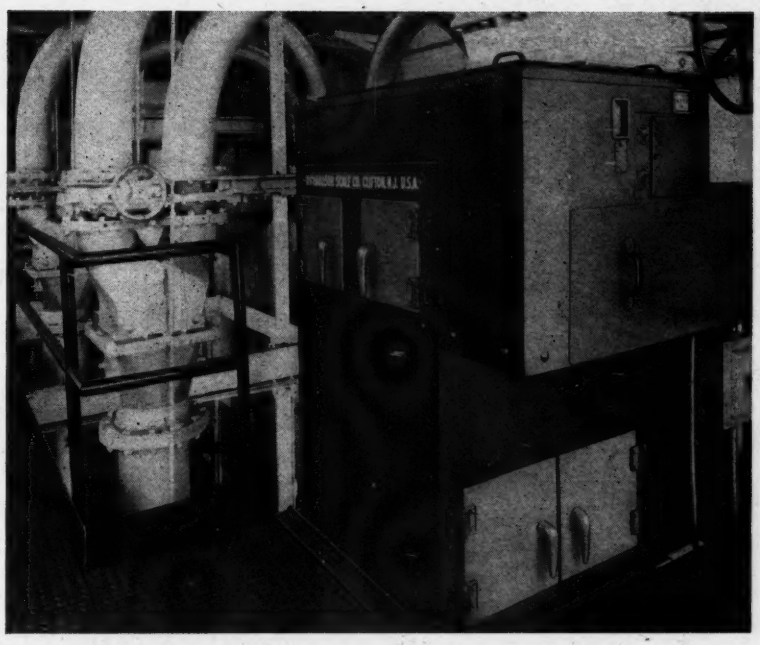

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More power from every ton of coal!

• In peace economy means profit. Now, more important, economy means more production.

Here in the Rock Hill Printing & Finishing Co., at Rock Hill, South Carolina, five Richardson Coal Scales increase production by keeping a constant and unfailing check on coal consumption.

In average installations, users report Richardson Coal Scales help to increase steam production from 5 to 10% because of accurate records of coal consumed by each boiler, enabling operators to keep boilers operating at maximum efficiency continuously.

You too can get increased production and efficiency from your boilers with Richardson equipment. Do it now.

Let us show you how.

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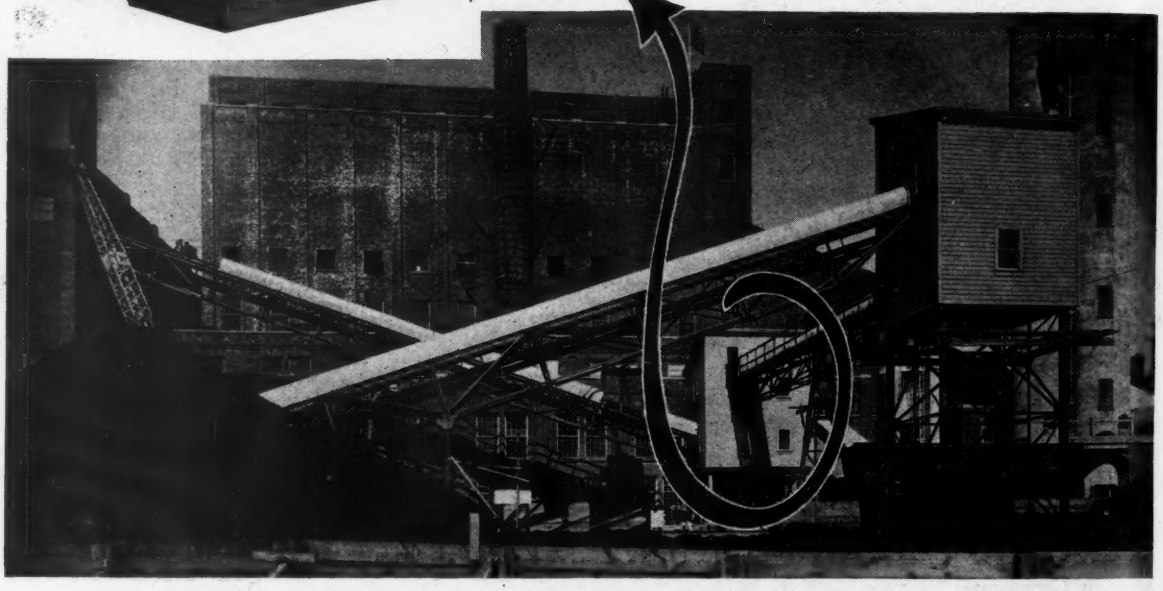
The "AMERICAN" WAY is the ECONOMICAL WAY to SIZE COAL...



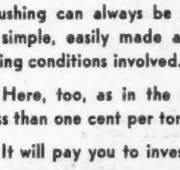
That's the verdict of the Maine Seaboard Paper Company

The "American" Ring Crusher at this big paper plant in Bucksport, Maine, is housed in the small building in the center of the picture. The installation is so compact that the photographer couldn't get a good shot of the equipment itself.

In this "way down East" plant, as in others in all parts of the country, the "American" way of preparing coal contributes to greater production, more steam and lower steam costs. Proper crushing can always be depended on to specific requirements because the "American" provides a simple, easily made adjustment to obtain exactly the size crushed coal required to meet the firing conditions involved.

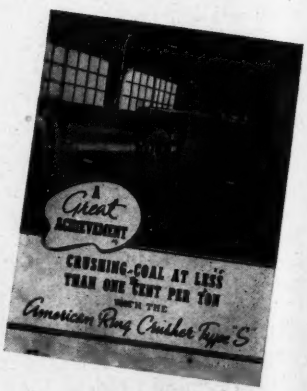
Here, too, as in the other plants where "AMERICANS" are installed, crushing costs average less than one cent per ton for both operating and fixed charges.

It will pay you to investigate the many features offered in "AMERICAN" Ring Crushers.



THE "AMERICAN" WAY SPLITS THE COAL

Instead of crushing coal with the possibility that clogging might result, the "AMERICAN" sizes the coal exactly by splitting it. This is accomplished by means of manganese steel shredder rings, an exclusive "AMERICAN" feature.



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1429 Macklind Avenue
St. Louis, Missouri
ORIGINATORS AND MANUFACTURERS OF RING CRUSHERS AND PULVERIZERS

"I'm gonna plug him right here...
'TAINT RIGHT TO LIVE FOREVER!"

You might get tired of having great-granpop around, but you'll never get tired of having Chapman List 960 Forged Steel Valves on your lines. And these small valves sure do seem to live forever . . . *long outlive* any other similar type of small valve. That's because of the new exclusive Chapman process that superhardens the renewable stainless steel seats and plugs. All the old familiar small-valve troubles are out when List 960 goes in. Prove it for yourself, on any line from ¼" to 2" . . . at any pressure up to 800 lb. at 750° F., or any cold working pressure up to 1500 lb. Inside or outside rising stem models. Write. The Chapman Valve Mfg. Co., Indian Orchard, Mass.

. . . and it's the same way with

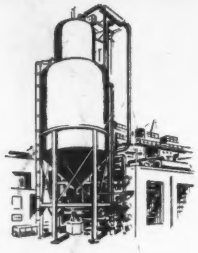
CHAPMAN LIST 960

SMALL GATE VALVES

with Superhardened, Long-Lived Seats and Plugs

HELPING TO KEEP THOSE SMOKESTACKS *BUSY*–

PERMUTIT SILICA REMOVAL PROCESS



4 features of Permutit's Mag-de-Sil* process:

1 Removes silica and does not increase total dissolved solids.

2 Economical . . . moderate amounts of low-cost reagents used.

3 Adaptable to hot or cold lime soda water softeners.

4 Applicable to existing equipment or special units may be installed.

PREVENT SHUTDOWNS . . . by using boiler feed treatment to fit your plant

Deposits of silica scale in boiler tubes, superheaters and turbines is only one of the many ways in which improper feed water may cut capacity at power plants. Permutit prevents these troubles, provides a water conditioning process to fit every raw water condition, every individual plant requirement. Now more than ever you need this protection at your plant. Write for booklet: The Permutit Co., Dept. A1, 330 West 42nd St., New York, N. Y.

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